JOURNAL

OF THE

AMERICAN WATER WORKS ASSOCIATION

VOL. 1 JUNE, 1914 No. 2

CONTENTS

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JOURNAL

OF THE

AMERICAN WATER WORKS ASSOCIATION

The Association is not responsible, as a body, for the facts and opinions advanced in any of the papers or discussions published in its proceedings.

VOL. 1 JUNE 1914 No. 2

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Members per last report:			
Honorary	7		
Active	869		
Corporate	65		
Associate	113		1054
Elected:			
Active	112		
Corporate	6		
Associate	16		134
			1188
Losses:			
Active: Died	4		
Resigned	10		
Dropped	44	58	
Corporate: Resigned	1		
Dropped	2	3	
Associate: Resigned	5		
Dropped	2	7	68
Present membership			1120
Present membership:			
Honorary	7		
Active	923		
Corporate	68		
Associate	122		1120

IN MEMORIAM

WALTER S. BROWN, Bethlehem, Pa. ..... July 13, 1913
CHARLES J. LEWIS, Hannibal, Mo. ..... February 22, 1914
JOHN L. LEAL, Paterson, N. J. ..... ——, 1914
BENNEZETTE WILLIAMS, C. E., Chicago, Ill. ..... June 22, 1914

ATTENDANCE AT THE PHILADELPHIA CONVENTION

Active Members		322
Associate Members		173
Guests: Men	214	
Ladies	188	402
		897

LIST OF EXHIBITORS AT PHILADELPHIA CONVENTION

Anchor Packing Co.
American Bitumastic Enamels Co.
American City
American Cast Iron Pipe Co.
Anderson & White
Borgner Fire Brick Co.
Badger Meter Co.
James Boyd & Bro. Inc.
Builders Iron Foundry Co.
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Birch Valve & Mfg. Co.
Chapman Valve Mfg. Co.
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Pitometer Co.
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United Lead Co.
Water Works Equipment Co.
Thomas Watkins

1915 CONVENTION

The 1915 Convention will be held at Cincinnati, Ohio, May 11–14

Mr. John W. Hill is the General Chairman of the Local Committee of Arrangements, Mr. Frederick C. Bitgood, Vice Chairman, and Mr. Seabury G. Pollard, General Secretary.

The Complete local organization will be announced in the next issue of the Journal.

The early organization, the personnel of the committee so far effected, promise great things for the Cincinnati convention, and it is not too early for members to begin their arrangements for attending.

There will be a Superintendents' Day, and all practical water works managers are requested to be ready to contribute something. Commence now to ask questions. Send them to the Secretary of the Association. Suggest subjects for papers and discussions, and gather material for a paper. All members are expected to suggest topics to authors for papers for the convention, and to contribute papers.

The Philadelphia convention was a great one, and every member should get busy to help make the Cincinnati convention equal it in every way. We must not go backwards!

MINUTES OF PROCEEDINGS THIRTY-FOURTH ANNUAL CONVENTION AMERICAN WATER WORKS ASSOCIATION

The Thirty-fourth Annual Convention of the American Water Works Association was held at the Bellevue-Stratford Hotel, Philadelphia, Pa., on May 11, 12, 13, 14 and 15, 1914.

MONDAY EVENING, MAY 11

At nine o'clock on Monday evening, May 11, a reception was tendered to visiting members, and their guests, by the Philadelphia hosts, at which refreshments were served, with music and dancing in the main ball room on the first floor of the Bellevue-Stratford.

The following were the Local Committees in charge of the various convention arrangements:

PHILADELPHIA LOCAL COMMITTEES

RECEPTION COMMITTEE

Hon. Rudolph Blankenburg, Mayor, Chairman

Mr. Samuel Bodine	Rev. R. H. Conwell
Mr. Morris L. Cooke	Mr. N. T. Folwell
Mr. Alba B. Johnson	Mr. Joseph B. McCall
Mr. T. E. Mitten	Dr. Edgar Fahs Smith

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Mr. A. W. MacCallum	Mr. J. W. Ledoux
Mr. H. G. H. Tarr	Mr. C. W. Summerfield

Mr. John C. Trautwine, Jr.

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Mr. W. H. VanWinkle, Jr.	Mr. I. S. Holbrook

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Mrs. Seth M. Van Loan	Mrs. N. E. Bartlett
Mrs. E. M. Hoopes, Jr.	Mrs. G. M. Costello
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Mr. F. W. Shepperd, Chairman

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Mr. H. M. Lofton

EXHIBITION COMMITTEE

Mr. Walter H. Van Winkle, Jr., Chairman

Mr. T. D. Faulks	Mr. V. E. Arnold
Mr. F. W. Sleep	Mr. G. M. Keefer

FIRST SESSION—TUESDAY MORNING, MAY 12

The first session of the Convention was called to order by President Thomas at ten o'clock Tuesday morning, in the magnificent auditorium of the Bellevue-Stratford Hotel, all of the executive officers being present with the exception of Vice-President George G. Earl, New Orleans, La., and Trustee Leonard Metcalf, Boston, Mass.

Roll call and reading of the minutes of the last Convention were dispensed with.

President Thomas called for the report of the Executive Committee, the recommendations in said report and action thereon by the Convention being as follows:

The Executive Committee recommended that the second paragraph of Section 2, Article IV of the constitution be amended to read as follows:

> A majority affirmative vote of the Membership Committee shall elect to Active, Corporate or Associate Membership subject to review by the Executive Committee.

On motion of Mr. Leisen, the foregoing amendment was adopted.

The Executive Committee recommended that Section 6 of Article III of the constitution be amended to read as follows:

SECTION 6. When an active member so changes his vocation that were he to apply for membership he would be classed as an Associate Member, he may continue as an Active Member with all the privileges of that grade, except that he shall not be eligible to any elective office in the Association.

On motion of Mr. Henderson, seconded by Mr. Randall, the foregoing amendment was unanimously adopted.

The Executive Committee recommended that various Sections of Article VI of the constitution be amended so as to change the method of electing the Vice-President, the said Sections when so amended to read as follows:

SECTION 3. At least sixty days before each annual meeting of the Association the Secretary shall mail to each Active, Honorary, or Corporate Member a blank upon which the member may express his choice for President, Vice-President, Treasurer and two Trustees. The Secretary, in conjunction with two other members to be designated by the President, shall count all nominating ballots received by the Secretary not later than thirty days before the date of the annual meeting.

The three members who shall have received the greatest number of nominating ballots for the office of President, the three members who shall have received the greatest number for Vice-President, the three members receiving the greatest number for Treasurer and the six members who shall have received the greatest number for Trustees shall thereby be placed in nomination. If there be a tie vote among the number required to be placed in nomination, an additional number of names to cover such ties shall be placed in nomination.

Tickets shall be printed on which the names of nominees shall be placed in the order of preference, the name of the person receiving the greatest number of nominating ballots for each office to be placed at the top of the list of nominees for that office.

SECTION 4. The election shall be by letter ballot. At least twenty-one days before the date of the annual meeting, a ticket shall be mailed to each member of the Association entitled to vote. Each member shall be entitled to vote for one candidate for President, one candidate for Vice-President, one candidate for Treasurer and two candidates for trustees.

The ballot shall be sealed separately in a special ballot envelope. This ballot envelope shall be enclosed in a larger envelope and forwarded to the Secretary. The signature of the member voting shall appear on the outer envelope.

The Secretary with two canvassers appointed by the President shall meet at a time and place directed by the President, and shall open and count all ballots cast by persons entitled to vote. No ballot shall be counted if received later than seven days previous to the beginning of the annual meeting.

The result of the canvass for President, Vice-President, Treasurer and Trustees shall be declared by the President at the annual meeting on certification of the canvassing board.

The member who shall have received the plurality of the votes cast for the office of President shall be declared elected. The member receiving the highest number of votes for Vice-President shall be declared Vice-President. The member who shall have received the highest number of votes for Treasurer shall be declared elected. Subject to the provision that no two trustees shall be residents of the same State, the two members who shall have received the greatest number of votes for Trustees shall be declared elected.

If there be a tie vote the President shall order a vote to be taken in the annual meeting to decide which person of those who shall have received the same number of ballots shall be chosen.

The terms of the officers so elected shall be as follows: For the President, Vice-President and Treasurer, each one year beginning with the close of the last day of the annual meeting and ending the last day of the next annual meeting, or until his successor shall have been chosen; for the Trustees, three years beginning with the close of the last day of the annual meeting.

SECTION 8. The President, Vice-President, and Trustees shall be ineligible to election for a consecutive term.

On motion of Mr. Leisen, the foregoing amendments to Article VI were unanimously adopted.

The Executive Committee reported that they had by unanimous vote forwarded a telegram of regret and sympathy to Past President Dow R. Gwinn, at present ill at Battle Creek, Michigan.

The Committee further reported that it had approved the action of the Finance Committee fixing the bond of the Treasurer in the sum of $5000, and that it had also fixed the bond of the Secretary at $1000, which action by the Executive Committee was duly approved.

The Executive Committee further reported that it had authorized the appointment of a Special Committee of Three from this Association to attend the official funeral of the Philadelphia heroes of the strife in Mexico, whose obsequies would be held by the City of Philadelphia on Wednesday, May 13, 1914.

This action being approved by the convention, President Thomas named as such official representatives Messrs. John C. Trautwine, Jr., Philadelphia; Timothy Woodruff of Bridgeton, N. J., and William R. Young, of Minneapolis, and further requested Mr. John C. Trautwine, Jr., as the Chairman of the delegation, to draft suitable resolutions, for adoption by the Association later, commemorating the dead soldiers.

The Reports of the Committee on Permanent Headquarters, both the Majority and Minority reports, were read, as follows:

MAJORITY REPORT—COMMITTEE ON PERMANENT HEADQUARTERS

April 21, 1914.

To the American Water Works Association,

Gentlemen: Your Committee recommends that the Executive Committee be authorized to secure an office for permanent headquarters in the City of New York, preferably in the Engineering Building on 39th Street, and to provide a Secretary and such assistants as may be necessary to keep the headquarters open and to perform the necessary work of the Association.

The Committee estimates that an additional expenditure of $2500 to $3000 per annum will probably be incurred in carrying out this recommendation.

The Committee recommends that the dues of members be increased to make this amount of money available without otherwise limiting the work of the Association.

The present number of active and corporate members is about 950, and an increase of about $3 per member per annum will be required.

The Committee recommends that the dues of active and corporate member be increased to $8 per annum, and that no change be made in the dues of associate members.

Respectfully,

ALLEN HAZEN, *Chairman,*
W. P. MASON,
GEO. H. FELIX,
RUDOLPH HERING,
Committee on Permanent Headquarters.

MINORITY REPORT—COMMITTEE ON PERMANENT HEADQUARTERS

May 4, 1914.

To the American Water Works Association,

Gentlemen: The minority begs to recommend that, while permanent headquarters are desirable, and could probably add sufficiently to the value of the association to warrant an increase of dues, such a step is inopportune for the following reasons:

1. The field of this association is properly the operatives of the water works and it will not reach its fullest usefulness until nearly all the water works are represented. To secure this result moderate dues are believed to be requisite.

2. The recent financial history of the association is not good. A voluntary subscription lately has been required, and the temper of the response thereto has not been such as to warrant the belief that an increase in dues would be popular.

3. We are just embarking upon the formation of sections, including the publication of a quarterly journal and the refund of one-quarter of each five dollars paid in dues for the local expenses of the sections. There are kindred organizations considering enrollment having dues less than five dollars, to which an increase of dues even to our present dues of five dollars is considered a hardship. To further increase our dues it is believed will greatly discourage additions to our membership from this source.

4. Of the present membership, to those who attend Conventions an increase of dues is a small matter, but the great majority of the membership receives little benefit except from the journal, and many of these members will be lost through an increase in dues, and the net result of the increase will be less than is indicated by the present enrollment and the increase in dues per member.

It is believed that a large enrollment and a sound financial policy will ultimately bring permanent headquarters, but that it would be a backward step to attempt its accomplishment at this time.

CHAS. B. BURDICK,
Committee on Permanent Headquarters.

The Executive Committee recommended the adoption of the Minority Report of the above Committee, and on motion of Mr. Caulfield this recommendation was concurred in, and said Minority Report was adopted.

REPORT OF COMMITTEE ON NATIONAL BUREAU OR DEPARTMENT OF HEALTH

To the American Water Works Association:

Your Committee appointed originally with a view to the prevention of unnecessary pollution of rivers and lake waters, and which problem it was thought could be solved best by a National Bureau of Health, submits herewith its report.

Since the first appointment of this Committee, a number of changes have taken place in one of the departments or bureaus of the National Government; changes which have affected both the title and the source of its authority, and which have materially enlarged the scope of its endeavors. This department is now known as the "United States Public Health Service," and is under the Treasury Department.

It is conducting a series of exhaustive investigations along the lines of sewage pollution of our lakes and rivers, some of the reports already having been published, and others are now being prepared for publication in the near future. The result of the investigations of the international boundary waters, the Great Lakes and connections, and of the Missouri River, have been issued in bulletin form, and similar work now being done along the Ohio River under the direction of Dr. W. H. Frost, is nearing completion, and these results will be published soon in another bulletin of the Public Health Service. The paper by Dr. Allan J. McLaughlin, to be presented at this convention, will deal with the work of this department and will afford a clearer conception of the scope of its endeavors.

While the work described is but the preliminary step and is entirely of an investigative nature, it is the essential and natural precursor of preventative measures, and it is reasonable to assume that the powers behind the present efforts will eventually follow them up with such recommendations as will result in the passage and enforcement of a code of laws or regulations that will at least diminish, if it cannot totally prevent, the unnecessary pollution of the sources of our water supplies.

In the light of the foregoing facts and the belief that this work is now in the hands of men whose object will be the accomplishment of those ends for which your Committee has striven, we submit this as a final report, with the suggestion that the Committee, under its present title, be discontinued.

We believe, however, that as the question of stream and lake pollution is one of vital importance to the interests represented by the American Water Works Association, our efforts towards its prevention should not terminate with the dissolution of this Committee, and, therefore, we recommend that a committee of three, under the title of a "Committee on Prevention of Stream and Lake Pollution" be appointed with a view to keeping the subject before the Association, and the accomplishment of such beneficial results in this particular field as the earnest endeavors of such committee may find possible.

Respectfully submitted,

THEODORE A. LEISEN, *Chairman.*

On motion of Mr. Caulfield, the Report was received and accepted, and the Committee discharged.

REPORT OF COMMITTEE ON TABULATION OF RATES AND OTHER INFORMATION

Mr. F. C. Jordan, Chairman Committee on Tabulation of Rates and Other Information, presented the very comprehensive and voluminous Report of that Committee,

NOTE: Full report of Committee follows the minutes in this *Journal.*

President Thomas congratulated Mr. Jordan and his Committee upon the very valuable and interesting data compiled by them, for which he said that Mr. Jordan particularly deserved a great deal of credit, and called for a discussion of the Report.

Mr. Caulfield moved that the Report be accepted and adopted, published in the *Proceedings*, and the Committee discharged, with the thanks of the association.

Mr. Worrell moved as an amendment that the Report be published in separate pamphlet form as soon as possible, and this amendment was accepted by Mr. Caulfield.

Mr. Maury moved as an amendment to the original motion that the matter of publishing the Report in separate pamphlet form be referred to the Publication Committee for action; which amendment, being put to vote, failed to carry.

Mr. Kimball thought that the matter contained in the Report was of sufficient importance to justify its being issued in separate pamphlet form, and a sufficient number of copies printed to supply

all interested. That it would be of substantial value to the members he had not the slightest doubt.

Mr. Caulfield desired special publication of the Report at as early a date as possible; and Mr. Houston thought that the matter should be acted upon by the Convention.

The motion to print the Report in separate pamphlet form was now put, and carried unanimously.

His Honor, Rudolph Blankenburg, Mayor of Philadelphia, was now announced, and was received by the Convention standing, and with applause.

The Chair recognized Mr. Carleton E. Davis, Chairman of the Local Committee of Arrangements, who introduced the Mayor as follows:

Mr. President and Members of the Association: Mayor Blankenburg's administration stands for a hearty welcome to everything that is best in municipal life. He and his Directors stand for the principle of testing all things and retaining that which is good. With that end in view, his Honor invited the American Water Works Association to hold their Thirty-fourth Annual Convention in this city. He knew that the city would derive benefit from a visit of this Association; he felt that you also would be benefited by coming here. The Mayor is here in person today to welcome you to the city.

I have the honor of introducing Honorable Rudolph Blankenburg, Mayor of Philadelphia.

ADDRESS OF WELCOME—HON. RUDOLPH BLANKENBURG, MAYOR

Mr. Chairman and Gentlemen: I wish Chief Davis had said that we are trying to give the best that is in us, and to do more than has ever been accomplished in Philadelphia as far as municipal administration is concerned. That has been our effort, and those of you who know the Chief of the Water Bureau, and the Director of the Department of Public Works, and all those associated with them, must agree with me that no city could have made or can make a greater effort than we in Philadelphia are doing to make good.

I welcome you, gentlemen, in the name of this great City of Homes. As its chief magistrate, I welcome you most heartily to Philadelphia, assuring you that you will be regarded by the citizenship at large

as men who have the power to confer great benefit upon the community. This, perhaps, more at the present time than ever before, because there is a certain wave going all over our broad land that will—I will not say in all probability, but possibly in the near future make water the only beverage we will be permitted to partake of. You must therefore see how important it is that the water we drink should be of the very best quality. I hope you will bear that in mind, Chief Davis.

For many years the water problem in Philadelphia was our greatest problem; the menace of bad water was in the mind of every one and very close to the hearts of all those who had the wellbeing of the city in mind and conscience. Typhoid fever found entrance into thousands of homes and took therefrom, in many cases, that which is the real life of the home and the inspiring force in the life and heart of the household.

We have made wonderful progress in the reduction of typhoid fever in Philadelphia, and that largely owing to the fact that we now have pure filtered—and sometimes double filtered water. After a large expenditure of money our difficulties in this direction have been mitigated, and we are now enjoying probably the best health conditions ever experienced in this old Quaker City.

But so fast is Philadelphia growing in this wonderful twentieth century that the machinery of filtration and distribution sufficient for the demands of one year, distinctly fall short of supplying the demand of the succeeding year. A little city of about 35,000 people confronts us with each new year as an addition to our working water supply, for that is the increase of our population every year. The problem is therefore one which requires the best effort of the best talent.

Your Association represents the best talent in this line, and the skill and experience of your members is not surpassed by water engineers of any country in the world; so that you are assured of a hearty and sincere welcome from our people.

This is an age in which there is noticeable everywhere a growing appreciation of the value of human life, and we recognize fully the truth that "no man liveth unto himself alone." Those who are charged with high administrative work are taking each day a deeper interest in the welfare of the citizenship entrusted to their care.

In common with other municipal executives throughout the United States, I clearly recognize the importance of the new problems

that have arisen with the increasing concentration of population in great centers.

Speaking, then, for myself, as well as for the people at large, I welcome your visit to Philadelphia, and express the sincere hope that your deliberations may develop new lines of action, improved methods of operation, and that out of this meeting in Philadelphia there may come benefit not only to our own city, but to every city throughout the length and breadth of this land that we all love so well.

Again assuring you of my hearty welcome, my deep interest in your work, and my feeling of appreciation of its high character, I extend to you the freedom of the city, with all the hospitality and hearty good will that is expressed in the words, "A real Philadelphia welcome!"

Let me add, Gentlemen, that the problems confronting the city and the state administration and the great government of our whole country, are becoming more complex every year, and this should develop in everyone that spirit which will force us to do our whole duty as citizens of the republic.

Unfortunately, politics too often invade municipal affairs and thus retard municipal progress. Since I have been Mayor of Philadelphia —and I speak thus to you because you represent all sections of the country—it has been my endeavor, in which I believe I have succeeded, to exclude politics absolutely from every department under my control. I have endeavored to give Philadelphia a business administration. Just as you in your lines of work and thought cannot succeed if you are guided by partisan considerations, so this great and glorious country of ours can endure only if every man and every woman is imbued with that patriotic spirit that has made possible the creation of our great republic.

Let me, then, ask you, Gentlemen, as you leave Philadelphia, the Cradle of Liberty; as you go to see in Independence Hall, the Liberty Bell, let that be an incentive to every one of you, as it has been to me, as it has been to my administration, to feel that this is not a country of dollars alone, as has often been charged, but that this is a country which will hold aloft the torch of light and liberty for all the world—a country that believes in a republican form of government.

Now, Gentlemen, you will excuse me if I take my departure. The office of Mayor of Philadelphia is rather strenuous. I have already welcomed the National Association of Hosiery and Underwear Manufacturers; I have now welcomed you; at two o'clock I have to open the Baby Saving Show in the City Hall; at four o'clock I have to

deliver an address at the German Hospital at the graduation exercises of the nurses; so you see the Mayor has a few duties to perform besides those that immediately pertain to his office.

I am very glad to have met you, Gentlemen.

RESPONSE BY PRESIDENT THOMAS

Mr. Mayor, speaking in behalf of the Association, I thank you for your very cordial welcome, your kind words, and also the inspiration of your address here today. I am sure that we feel highly honored at your presence, and that your good words will bear fruit with all of us.

I thank you for your very kind encomiums on the objects of our organization and the good work that is possible. Of course, we cannot assure you that we can make water take the place of other liquids. We can make it more wholesome and potable, but probably not as attractive as some other beverages.

I thank you sincerely in behalf of the Association for sparing us so much of your valuable time, and assure you that we feel honored. We have observed your administration and have reason to know from the appointments that you have made that your judgment is splendid, and as every American citizen must feel proud of the city of Philadelphia, he must also feel proud of its Mayor.

I will ask all present to give three cheers for Mayor Blankenburg.

(Three cheers and a tiger were given with hearty enthusiasm, as the Mayor took his departure.)

PRESIDENT'S ADDRESS

Ladies and Gentlemen: It is customary for the President at the first session of each Convention to make an address. I want simply to say, as President of the Association, that it gives me great pleasure to welcome you here, one and all, to this Thirty-fourth Annual Meeting, representing as you do, and as the Mayor has fittingly said, the intelligence, the capital, and the engineering capacity for doing great work.

Our membership includes men who have in the past designed and constructed some of the greatest water works systems in the world. We feel proud of our members who have done this; we feel proud of the American Water Works Association, because in some measure the work of this Association has been of assistance to those men in

their great work for the people of this country and of the whole American continent. Through the medium of the American Water Works Association you have become more or less familiar with every phase of water works management, of the mistakes, the failures and the shortcomings, all of which have been dwelt upon, as well as the successful solution of problems and the overcoming of difficulties. Not only does our membership get the benefit of the data and information contained in the papers read at the meeting and the discussion of those papers, but they also gather information from contact with men of experience at the meetings, who have had problems to solve and who have solved them successfully; and who, from their practical and actual performance of work can give the information that will be of the greatest importance and benefit to individuals who attend these meetings and who meet our various members, highly trained men and specialists, as well as the managers and operators of experience. I dare say that anyone seeking for enlightenment on any water works question can get full information either from the papers published in the Proceedings, or discussions, or from some individual who has had experience, probably precisely similar to the problem upon which information is sought.

Under the new Constitution which was adopted at the meeting in Minneapolis we have gone along the last year. One of the provisions of the Constitution is for more frequent publications, and we are now publishing a quarterly journal, which, of course, is of great advantage to those members who cannot attend our meetings. These journals will contain papers read at the annual meetings, and also papers read at the meetings of the several subordinate or local sections. This is another provision of the new Constitution which is bound to redound to the advantage of the organization as a whole and to the benefit of the members individually.

As an illustration of this, I had the great pleasure of attending the inception of the New York Local Section last September. It comprises members of this Society in New York and New Jersey. At the meeting there were probably about a hundred men from the eastern part of this country present, and it was a very enjoyable occasion. Papers were read there of great value. Of course, new membership from New York and New Jersey must inevitably follow the founding of this Section; and if similar Sections are started in other big centers of population where there are a number of surrounding cities and towns, the membership should take a great jump numerically, a result

greatly to be desired, not only in the interests of the Association, but also for the help that will be given in that way to the struggling water works officials who heretofore did not have the advantage of coöperation and instruction which association with other men in the same line affords and offers.

Besides the value to water departments and water companies of membership in this Association on account of the information obtainable from its papers and discussions, there is also the important work which the Association has done and is still doing in the way of prescribing standard and uniform specifications for pipe, hydrants, valves, etc.

The purchase of supplies and materials in accordance with uniform specifications would guarantee the purchaser against goods of inferior workmanship or design or both; and would also be an encouragement to honest manufacturers. In this day, when the tendency is to call for bids and to award contracts to the lowest bidders, the only safeguard is in standardizing everything as far as possible; and this work can be made an important function of this organization.

At present we have adopted pipe specifications and hydrant and valve specifications. We adopted the pipe specifications at Washington some years ago; last year we adopted hydrant and valve specifications. The effectiveness of these depend upon their universal use. As to the pipe specifications adopted, there is some variance between them and those adopted by other organizations, notably the New England Water Works Association. This difference, I am told, means increased expense to the pipe foundries, which, of course, must ultimately be borne by the pipe users, the water takers whom we represent; so that an agreement between the New England Water Works Association and the American Water Works Association on this matter would seem to be advisable.

To that end and for the purpose of bringing about standard specifications for both organizations, I appointed during the year on our Committee, Mr. F. A. Barbour, of Boston, who is also a member of the New England Water Works Association Committee. I understand that that Committee in their work as representing both Associations have gotten very close to an agreement, and it certainly would be very desirable if we only had one form of specifications for cast iron pipe and specials all over the country.

Regarding the hydrant specifications, some members of our Committee appeared at a meeting of the New England Water Works

Association and presented the matter with such skill and ability that they succeeded in having our specifications favorably acted upon and substantially incorporated into the specifications of the New England Water Works Association, thus indicating that it ought not to be a very difficult undertaking, but on the contrary, an easy one, to formulate specifications that would be standard at least in the United States. I am sure that Canada, so far as practicable, would fall in with the specifications standard in the United States. In the majority of cases the pipe specifications now used are those adopted by this Association, but in New England they follow the New England Water Works Association specifications; if we can reconcile the differences in these specifications we will have accomplished a most beneficial work.

Further, I believe that we should not stop at hydrant and pipe specifications, but should also take up uniform specifications for water meters. The consideration of these matters should be approached in a broad, fairminded manner.

Our complex membership of engineers who design water works, superintendents who manage them, and "associate members" who manufacture the supplies necessary for the operation of the works, are, or ought to be, equally interested in the success and welfare of the organization as long as it serves the public interests; and the manner and measure in which it does serve the public interest should be our chief concern, so that in the consideration of proper and uniform specifications for pipe, hydrants, valves, meters, etc., it is no betrayal of the interests of the organization or the public to consult and confer with the manufacturers in the particular matter under discussion, and we should welcome their participation in these matters. The associate members or manufacturers called upon in this way would be far more useful to the Association than as purveyors of entertainment.

It is a serious question whether the water works or supply men are not called upon for too much along this line, when we consider the cost of advertising in the journal, membership fees, and entertainment. Especially is this true when we stop to consider that this tax levied upon them is added to the cost of the goods they sell. Again, the water works official paid to attend these meetings is here for that purpose, and not for sport or amusement to the exclusion of business. Entertainment is all right and proper, but it should be managed so as not to interfere with the program of the Association, and the expense of it should not be borne by members of the Associate class entirely.

Every member should feel it incumbent upon him to contribute his

share of work for the success of the Association, particularly by presenting papers containing facts and figures that will throw light on the problems continuously arising in the water works business. These problems are becoming more pressing with the growth of population, which demands more water on the one hand, while there is an increasing pollution and a destruction of the sources of supply on the other hand by the consequent sewage and drainage from the increasing population.

Those charged with the responsibility for providing water of good quality and sufficient quantity, are helped very materially by knowledge obtained through this organization, not only through the papers read and published by the Association, but also by conversation with those members who may be rather backward about presenting papers.

I have said considerable regarding the work of the Association because the question is sometimes raised as to whether membership is worth while. This is a natural question for members and non-members alike to ask; but I believe that almost everybody connected with the water works business will readily admit that the printed *Proceedings* are worth more than the amount paid in fees; but it is not so easy to convince people that the expense of attending the meetings is money well spent. Apart from the fact that if no one attended the meetings there would be no organization and consequently no papers, there is also the further fact that considerable valuable information may be received from members in private interviews, and sometimes in this manner you may become possessed of facts which might prevent the waste of large amounts of money if you had to learn the same thing from your own experience. Many costly mistakes in the conduct of water works plants, both large and small, would have been averted, had the management of the plant consulted others of wider experience.

Many of you, no doubt, who have attended these Conventions long enough will remember that in the early days the attendance and the membership consisted chiefly of superintendents of water works, men who had been raised from the ranks and who came to these meetings in order to learn through the experience of others how to solve some particular problem in which they were at that time engaged, and they were also in return willing to relate their experiences—sometimes only too willing!

Those were the days before we knew much of "bacteria" or "B. Coli," or, in fact, filtration for filters for water works were not in use at

that time to any great extent, and most of their filters were of the slow sand type. Mechanical filters, which are in such general use now, were not then looked upon with favor by public officials.

The different growths in water were not than understood. Of course, the superintendents had an idea of what algae and crenothrix were, but very little was heard of anabaena, asterionella, and a thousand other plant growths. Of late years the old style of superintendents has given place more or less to men who possess technical education and who are styled "chief engineers," etc; so that to some extent the old-time superintendent of water works is passing, especially in the larger cities, and those who are still successfully operating works are indebted to the technical engineers for new ideas. As we come to the meetings now we must be impressed with the very much larger scope of the association and how it has broadened out to meet the enlarged field of work. That is another one of the reasons that makes this association a great help to the men who come to the meetings and listen to the papers of a technical character and profit by them, not only through the subject matter contained in the papers, but through contact with the men who write the papers, and who participate in the discussions. They meet these men and become acquainted with them, and the acquaintance may become of great use to the superintendent, the Water Commissioner or the member of a Water Board. They can take home what they learn here to help them solve their future problems, and they see the advantage of employing technical help to assist them to solve the various difficulties and problems that present themselves. At present, although some of our older members deprecate the idea that we do not have so many papers read by ordinary superintendents of water works, yet, on the other hand, we must not forget that we have the benefit of the work of these highly trained men who are specialists in their line, bacteriologists, chemists, and consulting engineers. Of late, too, we have the sanitary engineer, who is fast becoming a great factor in the designing of water works and the solution of water works problems.

To the superintendent of an older time the great problem was that of distribution. This question is not today as difficult as it was then. Good water at that time was not scarce, and it was not then a question of quality so much as quantity. Today quality is the great and difficult problem to solve; and the members of this Association who are consulting and sanitary engineers and bacteriologists are a great help to the Association, and I believe the superintendents feel very much indebted to them.

The consulting engineers of today are men of great ability and, as I said in the beginning of this address, have designed some of the greatest water works in the country. True, some of the engineers charge large fees; I heard of one consulting engineer, not very active in the American Water Works Association, whose charges would amount to a sufficient sum of money to build a reservoir in the old days. But we have to have them, it is a good thing for the Society, though not one of the advantages that is readily recognized.

This advantage, too, is reciprocal. These consulting engineers and technical men find that they can reach the superintendents through this Association in a better way and become better acquainted with them here than in any other manner.

I believe that this Association fills a very important place, and that every water works plant in America would be the gainer by membership in it and by its officers attending these meetings when practicable.

During the past year, as the Secretary has told you, we have increased our membership one hundred. It is to be hoped that the Association will continue to increase, so that in the near future every Superintendent of Water Works, every Water Registrar, Hydraulic Engineer, Sanitary Engineer, Bacteriologist, and all Specialists in Water Works will be included in its membership list. To achieve this result should be the aim and duty of every member. Our policy should be a broad one of coöperation with other similar organizations and toleration amongst ourselves. All attempts to use the Association for other than the general good should be discouraged and frowned upon. Never allow it to be exploited by cliques or factions. Beware of men who are inclined to inject personal interests or feelings into the conduct of the business of the organization.

A glance at the program of the meeting will show by the list of Committees that the Association has a vast amount of work ahead that will require close attention and united effort and will, we hope, prove helpful to the members in the solution of the problems involved. Comparatively few people in any community duly recognize the importance of their own water works system, the effect it has on the public welfare, and the many difficulties attending its successful management. Owing to this public indifference,—I might say ignorance,—the water works official meets with very little encouragement at home, so that he looks to us for support and assistance in his efforts to improve his plant, and recognition and appreciation for his good work, which, as all of us have reason to know, means a great deal.

The receipts of the Association up to April 1, 1914, were...	$6807.15
The expenditures were.....	6798.58
Excess of receipts over expenditures.....	8.57

These figures show that we are living very close to our income. The expenditures were mostly for office work and printing and do not represent the expense which officers and committee members have incurred in attending meetings, etc., and preparing reports similar to to the report which Mr. Jordan presented. These expenses have been borne by the several members of the committees, or by the companies or departments with which they are connected.

Again, the great question is, has this money been well spent? Is it worth while? The answer is to be found in the amount of good which the Association does, this is incalculable and not to be measured in dollars and cents. Still, the success and welfare of societies is often affected seriously by the condition of their finances, so that I believe that a strict supervision should be kept over these matters.

I want to say a word in conclusion in regard to the exhibits at this Convention. It is due to the Associate Members who have gone to the expense and trouble of making such fine a display as is here made, that every member of the Association should examine these exhibits and scrutinize them carefully, because, while you may have a general knowledge of the different apparatus that is there exhibited, yet there have been improvements which you might overlook, which would be of great advantage to you to be familiar with, and I bespeak for the supply men that our membership gives serious attention to these exhibits.

I want to thank you, Gentlemen, for your close attention and also wish to thank you again for the honor which you conferred upon me by electing me President at the meeting in Minneapolis.

We have received a report from the Canvassing Board, who counted the votes for officers elected for the coming year, and the Secretary will now read that report, to which I will ask you to please give your attention.

Secretary Diven then read the result of the ballot cast for election of officers, showing that the following had received a majority vote for the respective offices named, viz.:

President: Geo. G. Earl, General Superintendent Sewerage and Water Board New Orleans, La.

Vice-President: Nicholas S. Hill, Jr., Consulting Engineer, 100 William Street, New York City.

Treasurer: James M. Caird, Chemist and Bacteriologist, Troy, N. Y.

Trustees for term expiring 1917: Allen Hazen, Consulting Engineer, New York City; Allen W. Cuddeback, Engineer and Superintendent Passaic Water Company, Paterson, N. J.

President Thomas thereupon declared the foregoing duly elected to the respective offices named for the ensuing year.

The report of James M. Caird, Treasurer, was read, and with it the report of the Finance Committee, certifying to the correctness of the report, also certificate from the bank officials, as follows:

TREASURER'S REPORT

Troy, N. Y., April 1st, 1914.

Mr. H. E. Keeler, Chairman Finance Committee, American Water Works Association, Chicago, Ill.

Dear Sir:

Permit me to submit my report as Treasurer of the American Water Works Association for the year ending March 31st, 1914.

The funds of the Association are on deposit with the Troy Trust Company, Troy, N. Y., as per the orders of your Committee.

The receipts during the year were as follows:

From John M. Diven, Secy	$7,137.20
Interest on Deposit	57.34
Total Receipts	$7,194.54
Disbursements as per cancelled checks	6,130.30
Balance, April 1st, 1914	$1,064.24

Attached you will find certificate from the Troy Trust Company, showing a deposit of $3,876.26 at the close of business on March 31st, 1914. From this balance there should be deducted the following for unreturned checks:

Deposit as per certificate		$3,876.26
Unreturned checks as follows:		
J. M. Diven, Secretary	$157.82	
Henry Stowell & Son	99.19	
The Rumford Press	2,555.01	
		2,812.02
Balance		$1,064.24

The cancelled checks and the book of the Treasurer are submitted for audit.

The treasurer is under $5,000 bond as per order of your Committee.

Respectfully submitted,

JAMES M. CAIRD, *Treasurer.*

Troy, N. Y., April 21, 1914.

This is to certify that at the close of business March 31, 1914, the American Water Works Association had on deposit with this Company, the sum of Thirty-eight hundred seventy-six 26/100 ($3876.26) Dollars.

(Signed) H. K. DOWNING, *Treasurer.*

The foregoing report was accepted as read, and ordered printed in the *Proceedings*.

Mr. H. E. Keeler, Chairman, submitted and read the report of the Finance Committee, as follows:

REPORT OF FINANCE COMMITTEE

Philadelphia, Pa., May 11th, 1914.

To the Officers and Members of the American Water Works Association,

Gentlemen: Your Finance Committee would most respectfully report that they have examined and had audited the books, vouchers, cancelled checks, etc., of the Secretary and Treasurer of the Association, and are pleased to report that they find them correct in every detail and that they show care and thoroughness in the way the books and accounts have been kept.

The Association at the beginning of the fiscal year had a cash balance of $1337.96 and a cash balance at the ending of the fiscal year of $1064.24, showing a reduction for the fiscal year of $273.72. The Secretary's report in detail shows that there was received from all sources during the fiscal year $6807.15 and that the necessary and authorized disbursements for the same time were $6798.58, showing a net cash balance for the year's business of $8.57.

Owing to the delay in the issuance of the *Proceedings* covering the last Convention held at Minneapolis, the Secretary was unable to collect most of the bills covering the advertisements inserted in the *Proceedings*, in amount $766. These bills have since been collected and the amount of same will appear in the receipts of the current fiscal year.

We find from the Secretary's books about the usual amount of dues due from delinquent members, part of which undoubtedly will be collected and will show in the business of the current year.

We are pleased to report that there are no unpaid obligations of the Association for the past fiscal year.

The Association has on hand a considerable number of copies of *Proceedings* running from the year 1886 to 1913 inclusive, which are not carried as an available asset, although they will produce some revenue from year to year. We are informed by the Secretary that no insurance has been carried on these copies of *Proceedings* or office equipment, and we recommend that they be insured to the amount of one thousand dollars ($1000).

The contingent fund appropriated last year for Secretary's office expenses was not entirely used, and the unexpended balance has been transferred to the general fund. From this fund was purchased permanent office equipment to the amount of $108.40.

During the past fiscal year, the manner of printing the *Proceedings* has been changed from one large book issued after the annual convention to a quarterly journal which will undoubtedly be of great benefit and result in the transactions and papers of the Association being promptly placed in the hands of the membership and at the same time will require the payment for the necessary printing, etc., as the editions are issued, but as our finances are now arranged, we will

be able to carry on the business of the Association as outlined, including the printing of the journal and promptly pay all bills incurred in so doing.

In this connection, permit us to say that it seems to us very desirable that the Association have a little larger working balance. You will notice from our report, our working balance this past year was reduced fully 20 per cent, but we hope during the current fiscal year to be able, by proper economy and carefulness, to acquire a safe working balance which will enable the members of the Association to receive the greatest possible benefits due to the organization.

We appreciate the prompt and satisfactory rendering of their reports which we received at the hands of the Secretary and Treasurer.

Respectifully submitted,

H. E. KEELER, *Chairman*,
HOWARD A. DILL,
HENRY B. MORGAN,
Finance Committee.

On motion of Mr. Alvord, the foregoing report was received, and its recommendations concurred in.

Mr. Edward S. Cole, Chairman of Committee on Water Consumption, presented the report of said Committee as follows:

REPORT OF COMMITTEE ON WATER CONSUMPTION

Mr. President and Gentlemen:

Your Committee on Water Consumption was appointed to analyze water consumption statistics with respect to their bearing upon efficiency in general in water works management. Your Committee has not as yet completed its task, but has done considerable work, as I think we will be able to show you, in the preparation of the returns received from our members.

A blank questionaire was sent out early in the year, and the returns have been tabulated and computed as shown upon this blue print schedule. A great deal of valuable information has come into the hands of your committee, and the more we have studied it, the more we are convinced that it was the part of wisdom to have this analysis made.

We received something like 150 replies from various cities in the United States and Canada, as well as some foreign cities. Out of the replies that have been received, fully one-third were complete as to the analysis of metered consumption. The right half of the table relates to the classification of metered water, divided into industrial, commercial and public use. Where such classification was not possible, we called for the total metered consumption in domestic plants, and received many replies to such request.

Your committee considers that the showing made is very gratifying, considering the difficulty of obtaining segregated statistics of this character.

As you will see, there are a large number of blank spaces that remain to be filled in, and we expect in a short time to fill many of these. We will then revise our schedule and distribute it for examination by the members and officials, have the remaining blanks filled up, and this valuable data returned to us. That is our plan and our suggestion.

We hope that by the time the July Journal is published our report will be in shape to present to the Publication Committees for printing as a complete and revised schedule in the form very much as you see it here. It is our intention to make the classification of the cities and their returns based upon logical characteristics, such as percentage of meters, and the like. The data will be made up, completed, and presented to the Publication Committee at that time.

The subject of the conservation of water supply is one which is of increasing importance, and the matter of efficiency in management is also a matter of recognized importance. To arrive at this we must have a basis for comparing the efficiency of operation of one city with another. There are some cities in this country that report as high as 300 gallons per capita consumption, while others report as low as 50 gallons.

We believe that we should know the reason for this wide variation, and your committee believes that careful analyses of metered consumption in this way will throw light upon this subject, and afford valuable information to all of our membership.

Mr. J. N. Chester, a member of the foregoing Committee, in addition to the report, remarked as follows:

While, as Mr. Cole has expressed himself, the returns in many ways and the responses to the blanks sent out, have been gratifying, yet we have reason to expect a great deal more than we have received in the way of information that might be tabulated. What we are endeavoring to get at finally is the purely domestic consumption and it is the one hard thing to draw from you. It should not be however, especially in those states that have Public Service Commissions. I believe that, following the example of Wisconsin, every one of the States is going to require private water works, and in most cases municipally operated water works, to analyze their consumption in such a way that the information for which we are asking can be taken direct from their records.

I do not know what Wisconsin possesses in the way of private water works, but with 150 such plants in Pennsylvania, over 50 in Ohio, and 50 in Missouri, it is deplorable to see how sparsely our last column, which is, "Domestic consumption per capita," has been filled out.

We are going to send to each one of the cities tabulated here one of these blue prints, with the request that they check over the data that we have computed from what they have sent in, and write us as to the accuracy of the information before it is finally published. Let me urge that all of the 150 plants who will receive this blue print, scrutinize carefully the columns set opposite their plants, and see that all blank spaces are filled up before they send the blueprint back to us, and then the *Proceedings* will have in this report something worth while. Many of you who have been talking about consumption of 100 to 200 gallons per capita, will be very much surprised to find that the domestic consumption per capita is reported by many at so much less a figure than that, in some cases as low as 13 gallons per capita. We need something upon which we can base consumption, and if we can arrive at a correct figure for domestic consumption, we can add accurately for commercial and industrial consumption, and in this way begin at the bottom and work up.

On motion of Mr. Alvord, the Report of the foregoing Committee was accepted, the Committee continued, and the thanks of the Association tendered them for their valuable work.

Mr. Dabney H. Maury, Chairman of the Committee on Electrolysis presented the Report of that Committee, as follows:

REPORT OF COMMITTEE ON ELECTROLYSIS

Your Committee on Electrolysis would respectfully report that in view of the magnitude of the interests represented or controlled by the street railway companies, and in view of the fact that the decision of the United States Court in the Peoria case, copy of which formed a part of the last report of this Committee, gives small hope of relief to pipe owners, your committee feels that there is little chance that it can accomplish anything by further efforts in the work for which it was appointed. It would, therefore, request that the Committee on Electrolysis be discontinued.

Your committee can find nothing which it desires to change in its original recommendations, which were presented to this association thirteen years ago, and which it has since from time to time repeated.

Respectfully submitted,

DABNEY H. MAURY,
J. WALDO SMITH,
CHARLES R. HENDERSON,
Committee on Electrolysis.

Mr. Alvord remarked that the Committee had done a very useful work in keeping in touch with the situation in a general way, and calling attention to anything of interest, and he therefore did not believe it entirely desirable to discharge the Committee, but to have them continue in their watchful attitude, which he believed would be highly advantageous to the Association; and he would therefore move that the Committee be not discharged, but be continued for that purpose, and their present report accepted.

The motion carried, and the Committee was continued accordingly.

REPORT OF COMMITTEE ON STANDARD SPECIFICATIONS FOR HYDRANTS AND VALVES

In the absence of Mr. Little, chairman, Mr. J. M. Diven reported verbally that the committee had held two or three meetings during the year among themselves, and had also held a joint meeting with a similar committee from the New England Water Works Association, and that they had very nearly arrived at an agreement upon specifications which will be uniform between the two associations. However, there are some matters pending, awaiting action by the committee from the New England Water Works Association, before the committee from this association will be prepared to make its final report. He

therefore requested that the committee be continued to make its report next year. He believed that at that time a substantial agreement would be reached between the joint committees, and universal specifications arrived at.

On motion, the aforegoing verbal report was accepted, and the Committee continued.

Mr. John W. Alvord, Chairman of the Committee on Publication, submitted the Report of that Committee, which was received and accepted, as follows:

REPORT OF THE PUBLICATION COMMITTEE

To the President and Members of the American Water Works Association,

Gentlemen: Your Publication Committee would respectfully report that in accordance with the plans of the Special Committee, approved by the association, the first step has been taken to publish the proceedings of the association in a quarterly journal, beginning March 1914, the first copy of which has already reached the members.

It is needless to point out that the opportunity for members to get their papers published prior to the convention, and so reach the membership in time for a thorough discussion, is most desirable, and will hereinafter put a premium upon early preparation of papers, those reaching the committee, and being favorably passed upon in time for the March quarterly, being assured of better reading and discussion at the convention. The committee has been somewhat fearful lest this advantage should ultimately cause the March number to be notably more voluminous than the remaining numbers of the year, and one of its responsibilities is to obtain a good balance and sustain interest in the four annual issues.

The committee feels the association is to be congratulated upon the appearance of its first quarterly number. In some respects it is a drawback not to have the discussions accompany the papers, yet it is believed that this is more than atoned for by the early presentation of the papers, and their prompt appearance as received.

The Publication Committee feels that we are still involving ourselves in a notable experiment so far as cost and expense is concerned, and it yet remains to be seen what will develop in the way of additional literature and printing due to the formation of sections and the greater volume of literature which it is believed the sections will produce.

Until these questions are fully settled, and the success of the new undertaking is assured, it is believed to be desirable that careful attention to our finances be given, and no other experiments, involving large expenditures, be made until the assured success and stability of our new method of publication is fully demonstrated.

The committee would call attention to the clause in the new Constitution, which reads as follows:

"No papers containing matter either readily found elsewhere, especially advocating personal interests, carelessly prepared, purely speculative, or foreign to the purpose of the association, shall be accepted.

"The Publication Committee shall prepare rules, which, when approved by the Executive Committee shall govern the preparation, presentation and publication of all papers and such other matters of a similar nature as the best interests of the association may require."

The committee would report that it has not yet undertaken the preparation of the rules required by the new constitution and this is owing to the large amount of work which has been imposed upon it by the change in the method of publication and the necessity for close attention to other matters.

It is recommended that the next Publication Committee undertake this work of preparation of proper rules as required by the above clause.

All of which is respectfully submitted,

JOHN W. ALVORD, *Chairman.*

On motion, the Convention now adjourned to two o'clock p.m.

SECOND SESSION—TUESDAY AFTERNOON, MAY 12

President Robert J. Thomas in the Chair

Mr. George W. Fuller, New York City, not being in attendance at this time, the discussion of his paper on, "The Croton Water Supply, Its Quality and Purification" (printed in the March *Journal*), was passed pending the possible arrival of Mr. Fuller.

The paper by Dr. Allan J. McLaughlin, on, "Sewage Pollution of Boundary Waters" (printed in the March *Journal*), was discussed by Messrs. J. M. Diven, Superintendent, Troy, N.Y.; Edward Bartow, Director State Water Survey, Urbana, Ill.; W. H. Randall, Superintendent, Toronto, Ont.; F. A. Dallyn, Toronto, Ont.; Frank C. Kimball, General Manager, Summit, N. J.; Francis Ward Langstroth, Rahway, N. J.; C. Faller, Superintendent, Carlisle, Pa.; J. M. Caird, Chemist and Bacteriologist, Troy, N. Y.; George R. Taylor, Sanitary Chemist, Scranton, Pa.; Shepherd T. Powell, Resident Chemist, Baltimore, Md.; and E. E. Davis, Superintendent, Richmond, Va.

William Miller Booth, Chemical Engineer, Syracuse, N. Y., presented a paper on, "The Nitrate Test and Its Use in Detecting the Pollution of Waters," which was discussed by Prof. J. M. Caird, Troy, N. Y., and Shepherd T. Powell, Resident Chemist, Baltimore, Md.

A paper by W. U. C. Baton, on "Investigation into the Advisability of Substituting Agar for Gelatine as a Medium for the Determination of Bacterial Counts in Water Analysis" (printed in the March *Journal*), was not discussed at this time.

H. C. Hodgkins, Consulting Engineer, Syracuse, N. Y., presented his paper on, "Conservation of Potable Water and the Dual Sytem

of Distribution," discussed by Messrs. J. M. Diven, Superintendent, Troy, N. Y.; J. N. Chester, Hydraulic and Mechanical Engineer, Pittsburgh, Pa.; Francis Ward Langstroth, Rahway, N. J.; Daniel D. Jackson, Department of Water Supply, New York City, N. Y.; P. A. Maignen, Water Engineer, Philadelphia, Pa.; Frank C. Kimball, General Manager, Summit, N. J., and F. W. Cappelen, Consulting Engineer, Minneapolis, Minn.

Mr. Shepherd T. Powell, Resident Chemist, Baltimore, Md., delivered his paper on, "Some Observations of the Effect of Ozone Upon Algae Growth," remarking that he was not endeavoring to bring forward ozone as a new algaecide to take the place of copper sulphate, but merely to present some observations as to the effect of ozone on algae growth, which would be particularly interesting in the event that ozone ever gains a foothold as a general algae sterilizing agent.

The Committee upon Revision of Standard Specifications for Cast Iron Pipe and Specials, presented the following report:

REPORT OF COMMITTEE ON REVISION OF STANDARD SPECIFICATIONS FOR CAST IRON PIPE AND SPECIALS

NEW YORK CITY, N. Y., May 12, 1914.

To the American Water Works Association:

The Committee upon Revision of Standard Specifications for Cast Iron Pipe and Special Castings, begs to report that substantial progress has been made during the past year, but the committee is not yet ready to present to the Association a revision of the standard specifications for cast iron pipe and special castings.

The committee has continued to coöperate with a similar committee of the New England Water Works Association and also with representatives of the American Society of Mechanical Engineers, the Master Steam and Hot Water Fitters' Association, and with representatives of the manufacturers.

Your committee asks to be continued.

Respectfully submitted

JOHN H. GREGORY,
Chairman.

On motion, the foregoing Report was received, and the Committee continued.

On motion of Mr. Randall, the Convention adjourned to nine o'clock a.m., May 13, 1914.

THIRD SESSION—WEDNESDAY MORNING, MAY 13

President Robert J. Thomas in the chair

The following letter was read from President-elect George G. Earl, General Superintendent Sewage and Water Board, New Orleans, La.

NEW ORLEANS, LA., May 9, 1914.

Mr. Robert J. Thomas, President,
American Water Works Association,
Bellevue-Stratford Hotel, Philadelphia, Pa.

Dear Mr. Thomas: It is with very great regret that I find myself compelled to forego attending the Convention of the American Water Works Association this year. There are matters of the utmost importance in New Orleans that will transpire during the coming week necessitating my presence here.

I refrained from advising you of these conditions with the hope that at the last moment I would be able to arrange so that I could attend the Philadelphia Convention, but I find today that the urgency of these matters will not permit of my leaving the city.

With kindest personal regards, and a well wish for the success of the 1914 convention, and the continued growth and prosperity of the association, I remain,

Very truly yours,

GEORGE G. EARL.

The paper by Mr. George A. Johnson, Consulting Engineer, New York City, on, "Present Day Filtration Practice" (printed in March *Journal*), was discussed by Messrs. John H. Gregory, Consulting Engineer, New York City; P. A. Maignen, Water Engineer, Philadelphia, Pa.; Prof. James M. Caird, Troy, N. Y.; Charles B. Buerger, New York; George W. Fuller, Consulting Hydraulic Engineer and Sanitary Expert, New York; J. W. Ellms, Cincinnati, O.; W. C. Hawley, Chief Engineer and General Superintendent, Wilkinsburg, Pa.; J. N. Chester, Hydraulic and Mechanical Engineer, Pittsburgh, Pa; Theodore A. Leisen, Detroit, Mich.; Robert Spurr Weston, Consulting Sanitary Engineer, Boston, Mass.; J. W. Armstrong, Consulting Engineer, Baltimore, Md.; John C. Trautwine, Jr., Consulting Engineer, Philadelphia, Pa.; Robert Morgan, Peoria, Ill.; F. A. Dallyn, Toronto, Ont.; Paul Hansen, Engineer State Water Survey, Urbana, Ill.; Charles B. Burdick, Hydraulic and Sanitary Engineer, Chicago, Ill.; H. F. Dunham, Civil Engineer, New York City, and H. C. Hodgkins, Consulting Engineer, Syracuse, N. Y.

George E. Datesman, Philadelphia, Pa., gave a "Brief Review of Sewage Disposal Works in Some European Cities and Comparison

with the Pennypacker Creek Works, Philadelphia," illustrating the same with lantern slides.

Dr. Frederic D. West gave his paper on, "Disinfecting Two Hundred Million Gallons of Water Daily," which was discussed by Wilson F. Monfort, Chemist, St. Louis, Mo.; Robert Spurr Weston, Consulting Sanitary Engineer, Boston, Mass., and J. Walter Ackerman, Superintendent, Auburn, N. Y.

Mr. John C. Trautwine, Jr., Consulting Engineer, Philadelphia, Chairman of the special delegation appointed to attend the funeral of the victims of the strife in Mexico to be held on this day in Philadelphia, submitted and moved the adoption of the following resolution:

Resolved: That the American Water Works Association, in annual convention assembled at Philadelphia, Pa., May 11–15, 1914, hereby voices what must be the national sense of sorrow in view of the fact that young and potentially useful lives must still be sacrificed in human warfare which is happily giving way to methods worthy of respectful consideration by rational beings.

The resolution was unanimously adopted by rising vote.

The convention thereupon adjourned to nine o'clock a.m., Thursday, May 14, 1914.

FOURTH SESSION—THURSDAY MORNING, MAY 14

President Robert J. Thomas in the Chair

J. M. Diven, Superintendent Water Works, Troy, N. Y., read his paper on "Use and Benefits of Pressure Recording Gages" (printed in March *Journal*).

Discussed by W. E. Hazeltine, Manager Ripon (Wis.) Light and Water Company; A. A. Reimer, Superintendent, East Orange, N. J.; and J. Walter Ackerman, Superintendent Water Board, Auburn, N. Y.

J. Walter Ackerman, Superintendent Water Board, Auburn, N. Y., read his paper on "Testing of Check Valves" (printed in the March *Journal*) which was discussed by J. M. Diven, Superintendent, Troy, N. Y.; George Houston, Kalamazoo, Mich.; F. A. Dallyn, Toronto, Canada; and E. E. Davis, Superintendent, Richmond, Va.

The paper by Dr. Arthur Lederer and Frank Bachman on "The Efficiency of Household Filters in Chicago" was discussed by J. M. Diven, Superintendent, Troy, N. Y.; Dr. F. L. Rector, Brooklyn, N. Y.; Shepherd T. Powell, Baltimore, Md.; and Wilson F. Monfort, St. Louis, Mo.

Max von Recklinghausen presented his paper on "The Purification of Water by Ultra-Violet Rays;" which was discussed by F. A. Dallyn, Toronto, Canada; Shepherd T. Powell, Baltimore, Md.; and B. F. Shaw, Wilmington, Delaware.

The Question Box was now taken up and there being a good attendance present an active and interesting discussion ensued which was so generally participated in that the names of the participants will not be here enumerated but are published elsewhere in the full report of the discussion.

The discussion of the Question Box was suspended temporarily during the morning in order to install officers—elect and take action on place of holding the next annual convention.

President-elect George G. Earl, General Superintendent Sewage and Water Board, New Orleans, La., being unavoidably absent, the first officer installed was Vice-President-elect Nicholas S. Hill, Jr., Consulting Engineer, New York City, in presenting whom to the Convention President Thomas said:

The time for deciding the next place of meeting has now arrived. In former years this number on the program also included election of officers for the ensuing year. That, as I presume you all know, has been attended to by ballot; but I think it would be appropriate to introduce and install our newly elected officers. To our great regret, Mr. Earl of New Orleans, who was elected President, is not present much to his own chagrin and disappointment, due to conditions that were unavoidable. The other officers that were elected were, for Vice-President Nicholas S. Hill, Jr., New York City; for Trustees, Allen Hazen, who is unavoidably absent also in the western part of the country, and A. W. Cuddeback, Superintendent Passaic Water Company, Paterson, N. J. Otherwise your officers remain the same.

We have with us today, and it gives me great pleasure before taking up the matter of deciding the next place of annual convention, to present to you one that needs no introduction at my hands, for you all know him well, your Vice-President for the coming year, Mr. Nicholas S. Hill, Jr., of New York.

Mr. Hill was received with applause, and responded as follows:

Mr. President and Gentlemen of the American Water Works Association:

I do not think this association realizes how sincerely glad I am to be Vice-President of this association; not alone because of the honor that it entails, but chiefly because under the conditions named for the election of officers under the new constitution, I have come in second and Mr. Earl has been enabled to

be made President of the association; a recognition I think he justly deserves, and a consideration which made me feel exceedingly regretful when I heard that my name had been mentioned in the running. Mr. Earl entertained us so handsomely in New Orleans and has served this association acceptably so many times that I think it was only fair and just to him that he should have had this recognition, he having been the former Vice-President. So that in more ways than one I am thankful to you for the appreciation that you have shown to me personally, and more particularly for the appreciation shown to Mr. Earl.

The Convention then went into the matter of selection of next place of annual meeting, Secretary Diven stating that invitations had been received from the following cities, viz.: San Francisco, Cal.; Toledo, O.; Galveston, Tex.; Los Angeles, Cal.; Denver, Colo.; Chattanooga, Tenn.; Nashville, Tenn.; Salt Lake City, Utah; Columbus, Ohio; and Cincinnati, Ohio.

Secretary Diven further stated that postal cards had been sent out regarding the proposition of holding the 1915 convention in San Francisco, as an invitation had been extended at the last convention, and that 210 replies only had been received; 116 expressed a probability that they would attend such convention, 94 stated positively they would not attend and were opposed to it; the other 700 failed entirely to respond to the inquiry.

President Thomas appointed as tellers of election Messrs. Morris R. Sherrerd, Honorary Vice-President of the Association; J. Walter Ackerman, Superintendent, Auburn, N. Y., and Past-President Alex. Milne, and announced that all associate members under the constitutional provisions were entitled to vote for place of meeting.

A ballot having been taken, Vice-President Hill, temporarily in the Chair, announced the result as follows: Cincinnati, 160; Columbus, 43; San Francisco, 21; Los Angeles, 2; Salt Lake City, 19; Richmond, 4; Erie, 1; Philadelphia, 1.

Cincinnati having received the highest number of the votes was declared the place for holding the 1915 Convention.

The Convention now adjourned to two o'clock p.m.

FIFTH SESSION—THURSDAY AFTERNOON, MAY 14

President Robert J. Thomas in the Chair

A. A. Reimer, Engineer Water Department, East Orange, N. J., Chairman Committee on Standard Specifications for Wrought Iron Pipe, presented the report of the Committee as follows:

REPORT OF COMMITTEE ON STANDARD SPECIFICATION FOR WROUGHT IRON PIPES

To the American Water Works Association:

Your committee on standard specifications for wrought iron pipe, reports further progress during the period since the Minneapolis convention. It is becoming more and more apparent that the field to be covered in our work is exceedingly broad. It will be remembered that the investigation was extended by order of this Association to cover the general subject of rust-resisting metals, and this action at once opened to consideration an almost interminable list. Of course, many of these metals and their alloys can be eliminated from our study because of recognized physical characteristics, but new combinations and treatments are being presented constantly.

From this brief summary of our field of work, it will be seen that a final report, to be of value, must be postponed for some time. In fact, the feeling of some members of the committee is that a final report can never be presented, and that the technical reports, as presented from time to time, will be more or less advisory. Whether this view holds or not, the aim of the committee now is to present at the convention next year, a report giving the first definite results that have been obtained from the experiments and studies now under way.

Coöperation with the American Society for Testing Materials is now being sought, in order to avoid having two bodies cover the same ground in experimental work. The coöperation of various manufacturers has been offered and accepted within proper limits.

Certain definite gains have been accomplished since the formation of this committee. Some of the manufacturers are marking their produce with their name, as, for example, the Byers Company in wrought iron, and the National Tube Company, in steel pipe. The decision by some of the manufacturers to sell direct to large consumers, under specifications and mill inspection by the purchaser, thus eliminating the middle man, is a decided step in advance. Another point of value is the tendency of manufacturers to roll full weight pipe, thus placing all mills on the same weight basis.

The question of external coatings is receiving some attention, but the advance in methods of treatment of iron and other metals, either by alloys in the entire mass, or by subjection to "skin" or superficial treatment, offers an attractive field for investigation.

Again the Committee asks the hearty coöperation of the membership of the association in sending to us any points that can be used in our work.

We would suggest that this be received as a progress report and the committee continued.

Respectfully submitted,

A. A. Reimer,
Chairman.

On motion, the foregoing report was received, ordered spread upon the minutes, and the Committee continued.

The paper by Mr. John Gaub on "Some Economic Relations Between the Water Supply and Typhoid Fever as Shown by the Introduction of Filtration in Washington, D. C.," in the absence of Mr. Gaub was read by title.

The discussion of the Question Box was then resumed and occupied a considerable portion of the afternoon.

Mr. John Trautwine, Jr., Consulting Engineeer, Philadelphia, Pa., gave a lecture illustrated by lantern slides, descriptive of the Philadelphia Water Works from its origin to the present time. This lecture was much appreciated and enjoyed by those present, and Mr. Trautwine was complimented by President Thomas for the entertainment afforded.

Mr. A. A. Reimer, Superintendent, East Orange, N. J., at the close of the afternoon congratulated the Association upon the practical and interesting discussions that had been had, which he thought could not fail to be of great value, especially to the superintendents and others who were handling smaller plants, some of whom were not highly trained along engineering lines, so that the questions brought forward in the Question Box he believed were well worth the time given to them, and suggested that as "Superintendents' Day" had been such a success at this convention it would be well to continue the practice thus so successfully initiated by hereafter devoting one day of each annual convention to what might be called a Superintendents' or Executive Day, setting apart Thursday of the convention week, by which he believed that there would be accomplished a great part of what the Association was organized for. The resolution was received with applause and was seconded by Mr. Diven and stated by the Chair as follows:

Moved and seconded that our next meeting and hereafter, so far as we have the power to regulate it, that Thursday of the convention week each year be designated as "Superintendents' Day" and be devoted to the discussion of questions pertaining to practical management and operation of plants; in which form the motion carried.

The Convention now adjourned to eight o'clock p.m.

SIXTH SESSION—THURSDAY NIGHT, MAY 14, 1914

President Robert J. Thomas in the Chair

The discussion of the Question Box was resumed, after which Mr. Louis L. Tribus, New York City, delivered an interesting lecture, illustrated by lantern slides, entitled "Stray Notes on Water Supply."

President Thomas then introduced Dr. W. P. Mason, Professor of Chemistry Rensselaer Polytechnic Institute, Troy, N. Y., and Past President of this Association, to whom President Thomas referred as one who had very delightfully entertained the Association in the past.

The lecture dealt generally with various microörganisms and growths affecting water supplies, also related topics.

Mr. J. Walter Ackerman, Superintendent Water Board, Auburn, N. Y., then gave the paper describing the present status of certain litigation arising because of the pollution of the waters of Owasco Lake. The paper was discussed by Mr. Nicholas S. Hill, Jr., New York City, and Dr. W. P. Mason.

Dr. Edward Bartow, Director State Water Survey, Urbana, Ill., gave a paper, illustrated by lantern slides, his subject being "Laboratory Control of Water Supplies," and the slides being illustrative of the equipment of laboratories more especially suitable to smaller water works plants.

Mr. Paul Hansen, Engineer State Water Survey, Urbana, Ill., gave a paper entitled "An Undeveloped Field in Water Works Management."

President Thomas, after congratulating the Convention upon the enjoyable evening spent in listening to the interesting papers by Mr. Tribus, Dr. Mason, Dr. Bartow and Mr. Hansen, announced an adjournment until nine o'clock a.m. Friday, May 15.

SEVENTH SESSION—FRIDAY MORNING, MAY 15, 1914

President Robert J. Thomas in the Chair

Mr. Thomas suggested that as the Fire Protection Committee had had no occasion to make a report for several years it might be advisable to discontinue the Committee.

On motion the said Committee was discontinued with thanks.

The same action was taken with reference to the Committee on Uniform Annual Reports and Accounts.

Mr. Chester R. McFarland, Secretary and Superintendent, Tampa, Fla., inquired whether any work had been done by the Association with reference to ascertaining some uniform basis of rate making, which would be of great benefit especially to the newer water works plants, some fundamental principles upon which they could base their rates. Mr. C. W. Wiles, Superintendent, Delaware, Ohio, stated that he was a member of a committee that had been in conference with the Public Service Commission of Ohio advising with them on the subject referred to by Mr. McFarland, and that the Ohio Public Service Commission was desirous of getting all the information they could get from this body, as well as other bodies, on this subject.

A paper by W. E. Miller on "A Diagrammatic Method of Determining the Cost per Foot of Cast Iron Pipe" in the absence of the author was read by Secretary Diven. Another paper by the same author, W. E. Miller, on "The Individuality of Public Utilities, Particularly Water Works" in the absence of the author was read by Mr. H. E. Keeler, Chicago, Ill.

Mr. Nicholas Hill, Jr., Consulting Engineer, New York City, gave his paper on "Pipe Distribution Systems," illustrated by lantern slides.

Mr. John W. Alvord, Consulting Engineer, Chicago, Ill., followed with a paper on "Equitable Hydrant Rentals and Better Methods for Apportioning Fire Protection Costs" (printed in March *Journal*).

The foregoing papers were discussed by Mr. J. W. Alvord, Chicago; Edward S. Cole, Hydraulic Engineer, New York Ctiy; John C. Trautwine, Jr., Consulting Engineer, Philadelphia; Paul Hansen, Engineer State Water Survey, Urbana, Ill; J. N. Chester, Hydraulic and Mechanical Engineer, Pittsburgh, Pa.; W. S. Cramer, Consulting Engineer, Lexington, Ky.; H. E. Hodgekins, Syracuse, N. Y.; W. C. Hawley, General Superintendent, Wilkensburg, Pa.; J. M. Diven, Superintendent, Troy, N. Y.; Pat Gear, Superintendent, Holyoke, Mass.; F. W. Langstroth, Rahway, N. J.; J. Davis Barnet, Stratford, Ont.; Oscar Bulkeley, Engineer Water Department, Rockford, Ill.; A. A. Reimer, Superintendent, East Orange, N. J.; and Albert Blauvelt, Chicago, Ill.

N. W. Akimoff presented his paper on "Remarks on the Theory of the Pitot Tube" (printed in March *Journal*), which was discussed by J. W. Ledoux, Chief Engineer American Pipe and Construction Company, Philadelphia, Pa.

Secretary Diven read telegrams from Hon. F. M. Wooden, Mayor of

the City of Tulsa, Okla., cordially inviting the membership of the A. W. W. A. and guests to visit Tulsa during the Convention of the Southeastern Water Works Association, June 15–17, 1914; telegram was also read to the same effect from L. L. Ballard, Superintendent, Tulsa City Water Works.

A paper by L. Van Gilder, Engineer and Superintendent, Atlantic City, N. J., descriptive of the "New 48-inch Cast Iron Force Mains for Atlantic City, N. J." was read by title, and in that connection Superintendent Van Gilder extended a cordial invitation to the Convention to visit Atlantic City and inspect the laying of this main, also described how the party might en route observe the laying of the main from the windows of their train.

The transportation for the trip to Atlantic City on Saturday, May 16, was furnished by the courtesy of the Water Works Manufacturers Association, a special train being provided.

Mr. A. A. Reimer, Superintendent, East Orange, N. J., suggested that the successful efforts of the local entertainment committee should be recognized and moved that a vote of thanks and appreciation by the Convention be tendered to the various committees, including the Ladies' Entertainment Committee, for their many courtesies and efficient conduct of all of the arrangements in connection with the Convention program and entertainment.

The motion carried unanimously by rising vote.

Mr. John Caulfield, Secretary, St. Paul, Minn., moved that the thanks of the Convention be tendered to Hon. Rudolph Blankenberg, Mayor, and other officials and citizens of Philadelphia for courtesies tendered us during our visit to their city.

The motion carried by rising and unanimous vote.

Mr. John C. Trautwine, Jr., of Philadelphia, stated that although his name appeared in the list of the Committee of Arrangements, he felt that personally his labors had been very light in that connection and he desired that the credit be given to Mr. Carleton E. Davis, Chairman of the Committee, who he stated had done at least 90 per cent of the work, and that he had done exactly the same thing at the New England Water Works Association Convention, and Mr. Trautwine proposed to show him up every time he did it.

Mr. J. N. Chester, Pittsburgh, Pa., moved that a special vote of thanks be tendered Mr. Carleton E. Davis, Chairman of the Committee of Arrangements, for his personal work.

The motion carried by unanimous vote.

President Thomas insisted that Mr. Trautwine deserved recognition for his very interesting paper and entertainment afforded the Convention thereby.

Mr. John Caulfield heartily concurred in this expression and gave some reminiscences illustrative of valuable service of Mr. Trautwine to water works men generally and his laudable efforts in encouraging the use of meters.

A paper by Edgar M. Hoopes, Jr., and James M. Caird, on "The Water Supply of Wilmington, Delaware" (printed in the March *Journal*) was read by title, and President Thomas suggested to the Convention its especial relevancy in view of the fact that those attending the Convention were to go on a trip to the City of Wilmington, by invitation of the Wilmington Water Department, today; the party to visit the water works and filter plants, a light supper to be served at the filter plant, returning to Philadelphia in the early evening.

Just before concluding the Session President Thomas stated for the information of those present that as proof positive of the successful character of the Convention, numerically speaking, the Secretary had just informed him that the total registration was over 900, the largest in the history of the organization, and what was more to the point, there were registered 322 active members, being 100 more than had ever attended any previous Convention of the American Water Works Association. On the whole he felt that the meeting had been very successful, otherwise in the point of attendance, and he wished to thank the members for their attendance and promptness in being on hand at the opening of the various sessions. The papers read had been of a superior character and the discussions quite generally participated in. Superintendents' Day had proved an unqualified success and the discussions at that time had brought out many matters of value in regard to the operation of water works in which he believed the majority of the members were greatly interested, although not more so than the so-called specialists, engineers and technical men who had no doubt benefited as much as had the superintendents by these practical discussions.

No further business offering, on motion, the Convention now adjourned to meet in Cincinnati the week beginning May 10, 1915.

REPORT OF COMMITTEE ON TABULATION OF WATER RATES AND OTHER INFORMATION OF INTEREST TO WATER COMPANIES[1]

In presenting this report the committee desires to express its appreciation of the courtesy of the water works superintendents and others who have so graciously furnished the information contained herein and have by letter and word of mouth given suggestions and data which should be both interesting and valuable to our membership. We sincerely trust that the tabulation may prove "worth while" not only to the water works superintendent, but to the engineer, the city official, or the citizen interested in the subject of water supply.

The committee desires, however, to give expression to a strong word of caution against the liberal acceptance and use, for comparative purposes, of any segregated part or parts of this tabulation, it being an obvious fact that the only fair comparison which can be made between water departments will be that comparison which considers every condition surrounding the operation of the departments under comparison. As illustrative of this statement, we would cite the following examples:

1. A comparison of water rates for domestic consumption will be manifestly unfair unless every "cost item" is carefully considered. A city with a "frontage tax," an unfiltered water and an ordinance compelling all citizens to be patrons of the water department, can furnish water at "apparently lower rates" than another city operating its plant upon a different basis.

2. The hydrant rental in a certain city will be "apparently low" in comparison, until it is ascertained that high pressure is not maintained for fire service and that the hydrants are installed and kept in repair at the expense of the city. Another hydrant rental will be "apparently high" until it is ascertained that the pressure is increased for a fire service, that fire steamers are not used, and that the hydrant rental covers much "free water."

[1] Data compiled by F. C. Jordan, C. C. Cray, and W. G. Ulrich, of the Indianapolis Water Company, May, 1914.

3. The question of source of supply, quality of service, and liberality of franchise, are items which materially affect the operation of the plant, and a fair comparison will give due consideration to these items.

In the preparation of this tabulation, which has extended throughout the greater part of a year, the committee has become very much impressed with the truth and importance of the above mentioned facts, and accompanying this report is their request that careful thought be given to every item entering into the comparison, so that no city nor any superintendent shall be placed in an unfair light.

F. C. JORDAN, Chairman;
A. PRESCOTT FOLWELL,
F. H. DUNHAM,
F. H. SHAW,
GEORGE G. EARL,

Committee.

CITY	POPULATION, 1910	OWNERSHIP, WHETHER MUNICIPAL OR PRIVATE	SCHEDULE OF WATER RATES						NUMBER OF CONSUMERS	NUMBER OF METERS	METER RATE PER 1000 GALLONS		IS WATER TREATED
			House use 6 rooms	Bath	Closet	Wash stand and Laundry tubs	Sprinkling 40 feet with privilege of sprinkling roadway	Total			Maximum	Minimum	
Anniston, Ala	12,794	P	.....	.....	.....	.....	.....	.....	1,600	1,300	26.6	6	No
Bessemer, Ala	10,864	P	.....	.....	.....	.....	.....	.....	2,832	1,500	.....	.....	No
Birmingham, Ala	132,685	P	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mobile, Ala	51,521	M	.....	.....	.....	.....	.....	.....	11,769	2,223	15	5	Yes
Montgomery, Ala	38,136	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Phoenix, Ariz	11,134	M	12.00	3.00	6.00	.....	5.76	26.76	4,100	300	12½	12½	No
Fort Smith, Ark	23,975	M	8.00	2.00	2.00	.....	6.00	18.00	3,836	1,000	25	10	Yes
Little Rock, Ark	45,941	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pine Bluffs, Ark	15,102	P	.....	.....	.....	.....	.....	.....	2,077	2,077	40	15	No
Los Angeles, Cal	319,198	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oakland, Cal	150,174	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pomona, Cal	10,207	P	12.00	3.00	3.00	.....	6.00	24.00	2,800	1,900	22	10	No
Sacramento, Cal	44,696	M	12.00	.....	.....	.....	.....	.....	12,800	.....	.....	.....	No
San Diego, Cal	39,578	M	.....	.....	.....	.....	.....	.....	12,681	12,681	10	10	Yes
San Francisco, Cal	416,912	P	4.92	3.84	2.64	0.60	24.00	36.00	61,721	17,923	3	16	No
Stockton, Cal	23,253	P	8.40	1.80	1.80	.....	9.00	21.00	5,500	570	25	10	No
Colorado Springs, Col	29,078	M	12.00	1.00	2.00	.....	8.00	23.00	11,858	213	15	8	No
Denver, Col	213,381	P	.....	.....	.....	.....	.....	.....	43,819	330	.....	.....	Yes
Bridgeport, Conn	102,054	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bristol, Conn	13,502	P	6.00	3.00	3.00	.....	4.00	.....	1,848	1,351	18	5½	No
Hartford, Conn	98,915	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Manchester, Conn	13,641	P	8.00	3.00	3.00	.....	6.00	20.00	425	.....	.....	.....	No
Meriden, Conn	32,066	M	5.00	2.00	3.00	.....	5.00	15.00	4,500	618	15	10	No
New Britain, Conn	43,916	M	.....	.....	.....	.....	.....	.....	4,722	4,651	.....	.....	.....
New Haven, Conn	133,605	P	5.00	3.00	3.00	.....	6.80	17.80	.....	2,500	18	10	Yes

CITY	POPULATION, 1910	OWNERSHIP, WHETHER MUNICIPAL OR PRIVATE	SCHEDULE OF WATER RATES						NUMBER OF CONSUMERS	NUMBER OF METERS	METER RATE PER 1000 GALLONS		IS WATER TREATED
			House use 6 rooms	Bath	Closet	Wash stand and laundry tubs	Sprinkling 40 feet with privilege of sprinkling roadway	Total			Maximum	Minimum	
New London, Conn.	19,659	M	4.50	2.00	2.00	.....	5.75	.....	4,197	825	16	6	No
Stamford, Conn.	28,836	P	5.00	4.00	5.00	.....	.....	.....	3,800	2,200	20	20	No
Wilmington, Del.	87,411	M	5.00	3.00	2.00	1.00	7.00	18.00	19,331	7,574	10	5	Yes
Washington, D. C.	331,069	M	.....	.....	.....	.....	.....	.....	67,790	31,103	8	5	Yes
Jacksonville, Fla.	57,699	M	.....	.....	.....	.....	.....	.....	9,270	7,368	10	5	No
Tampa, Fla.	37,782	P	8.00	5.00	4.00	.....	8.00	25.00	6,495	1,383	22	12	No
Athens, Ga.	14,193	M	.....	.....	.....	.....	.....	.....	1,502	1,440	20	10	Yes
Atlanta, Ga.	154,839	M			(All metered)				25,434	24,670	10	7	Yes
Macon, Ga.	40,655	M	6.50	5.00	5.00	.....	12.00	28.50	5,682	2,600	20	8	Yes
Savannah, Ga.	65,064	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Boise, Idaho	17,358	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Alton, Ill.	17,528	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Aurora, Ill.	29,807	M			(All metered)				5,802	5,756	40¾	4	No
Belleville, Ill.	21,122	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bloomington, Ill.	25,768	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cairo, Ill.	14,548	P	6.00	3.50	3.25	.....	2.40	15.15	3,300	218	17	7	Yes
Champaign, Ill.	20,666	P	6.00	.....	.....	.....	8.00	.....	4,120	3,700	25	6	Yes
Chicago, Ill.	2,185,283	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Danville, Ill.	27,871	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Decatur, Ill.	31,140	M			(All metered)				5,300	5,492	20	5	Yes
Dixon, Ill.	7,216	P	5.00	3.00	3.00	.....	4.50	15.50	1,500	300	32	6	No
Elgin, Ill.	25,976	M			(All metered)				5,051	.....	.....	.....	No
Freeport, Ill.	17,567	P	5.50	.....	.....	.....	.....	.....	3,484	2,600	33	6	Yes
Kankakee, Ill.	13,986	P	5.00	3.00	2.50	2.00	4.00	16.50	3,292	277	25	10	Yes
Lincoln, Ill.	10,892	P	5.75	4.00	3.00	3.50	5.00	21.25	1,260	541	40	8	No

Oak Park, Ill.	19,444	M			(All metered)				5,043	5,043			
Peoria, Ill.	66,950	P	6.00	3.00	3.00		5.00	17.00	10,700	365	20	06	No
Quincy, Ill.	36,587	P	6.00	4.75	5.00	0.50	8.80	25.05	5,650	3,500	45	06	Yes
Rock Island, Ill.	24,335												
Rockford, Ill.	45,401	M	5.00	2.00	2.50		5.00	14.50	8,773	8,116	16	12	No
Springfield, Ill.	51,678												
Streator, Ill.	14,253	P	7.75	3.50	2.50		12.50	26.25	3,450	350	50	08	Yes
Anderson, Ind.	22,476	M	4.00	2.50	2.50	2.50	4.40	15.90	2,610	383	12	04½	Yes
Brazil, Ind.	9,340	M			(All metered)				850	820	26	06	No
East Chicago, Ind.	19,098	P											
Elkhart, Ind.	19,282	P	4.00	2.50	2.50	1.50	4.00	14.50	3,979	3,070	12	08	No
Evansville, Ind.	69,647	M	5.00	2.00	4.00	2.00	1.50	14.50	8,600	43	20	04½	Yes
Fort Wayne, Ind.	63,933	M							13,500	1,250	10	02½	No
Hammond, Ind.	20,925	M	12.00				2.00	14.00	5,000	700	12	03	No
Indianapolis, Ind.	233,650	P	5.00	3.00	3.00		6.00	17.00			18	04½	Yes
Jeffersonville, Ind.	10,412	P	6.00	5.00	5.00	4.00	7.00	27.00	1,100	102	40	15	No
Kokomo, Ind.	17,010	P	4.90	2.80	2.80	2.10	4.90	17.50	3,953	271	25	08	No
LaFayette, Ind.	20,081												
Logansport, Ind.	19,050	M							3,500	2			No
Marion, Ind.	19,359	M	4.44	2.22	2.78		4.20	13.64	3,680	784	15	06	No
Mishawaka, Ind.	11,886	M	2.00	2.00	3.00	3.00	3.00	13.00	1,500	200	12	05	No
Muncie, Ind.	24,005	P											
New Castle, Ind.	9,446	M	5.00	2.50	1.50	1.50	3.00	13.50	2,380	155	15	06	No
Richmond, Ind.	22,324	P	6.00	2.50	3.00	1.00	3.42	15.92	4,811	3,041	25	06	Yes
South Bend, Ind.	53,684	M	4.50	3.00	2.00	1.50	3.80	14.80	11,000	2,500	12	08	No
Terre Haute, Ind.	58,157	P	5.00	3.00	3.00		5.50	16.50	5,960	2,093	30	08	Yes
Vincennes, Ind.	14,895	P	5.10	3.50	5.00	2.00	7.00	22.60	1,600	235	50	15	Yes
Burlington, Iowa	24,324	P	6.00	5.00	5.00			16.00	4,178	200	25	10	Yes
Clinton, Iowa	25,577	P	6.00	5.00	3.00		5.00	19.00	3,994	2,122	30	06	Yes
Council Bluffs, Iowa	29,292	M	7.75	3.00	3.00	1.00	9.00	23.75	5,500	2,800	35	08	Yes
Davenport, Iowa	43,028	P	6.00	3.50	4.50		4.50	18.50	8,800	5,800	33	10	Yes
Des Moines, Iowa	86,368	P	4.00	3.00	3.00		7.50	17.50	15,004	14,553	30	10	Yes
Dubuque, Iowa	38,494	M							3,700	3,900			No
Iowa City, Iowa	10,091	P	5.00	3.00	3.00	1.00	10.00	22.00	1,415	117	40	08	Yes
Keokuk, Iowa	14,008	P	6.60	4.00	3.50		6.00	20.10	2,441	1,575	40	09	Yes
Muscatine, Iowa	16,178	M	6.00	3.00	4.00	2.00	7.00	21.00	2,800	250	35	06	No

CITY	POPULATION, 1910	OWNERSHIP, WHETHER MUNICIPAL OR PRIVATE	SCHEDULE OF WATER RATES						NUMBER OF CONSUMERS	NUMBER OF METERS	METER RATE PER 1000 GALLONS		IS WATER TREATED
			House use 6 rooms	Bath	Closet	Wash stand and laundry tubs	Sprinkling 40 feet with privilege of sprinkling roadway	Total			Maximum	Minimum	
Ottumwa, Iowa	22,012	M	8.00	5.00	5.00	.....	5.00	23.00	1,600	850	30	10	Yes
Sioux City, Iowa	47,828	M			(All metered)				6,200	6,221	25	10	No
Waterloo, Iowa	26,693	M	5.00	3.00	3.00	.....	.....	16.00	4,080	3,843	33	10	No
Atchison, Kansas	16,429	P	5.00	3.50	3.70	.....	4.00	16.80	2,405	340	30	10	Yes
Fort Scott, Kansas	10,463	M	8.80	3.40	2.20	.....	6.60	21.00	2,000	1,200	27½	07	No
Hutchinson, Kansas	16,364	P	.....	.....	.....	.....	.....	.....	4,000	3,000	30	10	No
Kansas City, Kansas	82,331	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lawrence, Kansas	12,374	P	6.00	2.00	2.00	2.00	8.00	20.00	2,087	75%	25	15	No
Parsons, Kansas	12,463	P	8.00	2.00	3.00	.....	7.50	20.50	2,424	1,800	30	10	Yes
Pittsburg, Kansas	14,755	M	8.00	2.00	2.00	.....	.....	12.00	3,817	962	50	11	No
Frankfort, Ky	10,465	P	6.00	2.50	3.00	1.00	6.50	19.00	.....	.....	15	06	.....
Henderson, Ky	11,452	M	5.00	2.00	3.00	.....	5.00	15.00	3,150	80	20	08	No
Lexington, Ky	35,099	P			(All metered)				5,130	5,130	.....	.....	Yes
Louisville, Ky	223,928	M	6.00	2.50	3.00	1.00	6.50	19.00	33,733	3,022	15	06	Yes
Newport, Ky	30,309	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Owensboro, Ky	16,011	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Alexandria, La	11,213	M			(All metered)				1,200	1,200	.....	.....	No
Baton Rouge, La	14,897	P	.....	.....	.....	.....	.....	.....	2,500	1,350	35	10	No
Lake Charles, La	11,449	P	13.20	.....	6.00	.....	21.00	40.20	625	7	50	25	No
New Orleans, La	339,075	M			(All metered)				33,959	33,873	10	07	Yes
Portland, Maine	58,571	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Baltimore, Md	558,485	P	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cumberland, Md	21,839	M	6.00	3.00	2.00	.....	3.00	14.00	4,285	4	.....	.....	Yes
Hagerstown, Md	16,507	P	10.00	.....	.....	.....	2.00	12.00	4,120	625	.....	.....	Yes
Arlington, Mass	11,187	M			(All metered)				2,366	2,366	20	13	.....

Beverly, Mass.	18,650	M	5.00	2.50	2.50	.....	3.00	13.00	4,405	726	20	20	No
Boston, Mass.	670,585	M	.....	.....	.....	.....	.....	.....	95,037	25,975	.....	.....	No
Brockton, Mass.	56,878	M			(All metered)				8,695	8,710	22	13	No
Cambridge, Mass.	104,839	M	4.00	3.00	2.00	2.00	5.00	16.00	16,194	5,045	20	10	No
Chelsea, Mass.	32,452	M	7.00	.....	5.00	.....	5.00	17.00	4,682	4,617	16	10	No
Clinton, Mass.	13,075	M	5.00	4.00	4.00	2.00	.....	15.00	1,856	1,680	33	08	No
Concord, Mass.	6,421	M	6.00	4.00	5.00	3.00	5.00	23.00	1,214	32	26	10	No
Everett, Mass.	33,484	M	7.00	.....	5.00	.....	5.00	17.00	5,660	1,900	16	10	No
Fall River, Mass.	119,295	M	5.00	2.50	5.00	2.50	6.00	21.00	8,988	8,988	28	10	No
Framingham, Mass.	12,948	M			(All metered)				2,058	2,063	33	12	No
Gardner, Mass.	14,699	M	10.00	3.00	3.00	.....	5.00	21.00	1,863	129	30	15	No
Gloucester, Mass.	24,398	M	6.00	6.00	6.00	3.00	5.00	26.00	4,771	399	30	15	No
Haverhill, Mass.	44,115	M	4.50	3.00	4.00	.....	5.00	16.50	7,054	1,543	21	10	No
Lawrence, Mass.	85,892	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lowell, Mass.	106,294	M	6.00	3.00	4.00	2.00	3.00	18.00	12,952	10,541	18	13	No
Lynn, Mass.	89,336	M	5.00	3.00	3.00	2.00	4.00	17.00	15,962	7,141	20	.....	No
Malden, Mass.	44,404	M	.....	.....	.....	.....	.....	.....	7,730	7,400	21	13	No
New Bedford, Mass.	96,652	M	2.50	2.50	2.50	2.50	2.50	12.50	13,643	9,998	15	02½	No
Newburyport, Mass.	14,949	M	6.00	4.00	4.00	2.00	5.00	21.00	3,485	110	28	14	Yes
Northampton, Mass.	19,431	M	6.00	2.00	2.00	.....	3.00	13.00	3,300	131	10	.....	No
Somerville, Mass.	77,236	M	.....	.....	.....	.....	.....	.....	12,596	7,164	16	16	No
Springfield, Mass.	88,926	M			(All metered)				13,407	.....	29	06	Yes
Taunton, Mass.	34,259	M	5.00	3.00	5.00	2.00	5.00	20.00	5,420	2,938	25	09	No
Waltham, Mass.	27,834	M	5.00	2.00	3.00	2.00	6.00	18.00	3,996	633	26	16	No
Winthrop, Mass.	10,132	M			(All metered)				2,655	2,655	19	.....	No
Worcester, Mass.	145,986	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Adrian, Mich.	10,763	P	5.00	3.00	4.00	1.50	7.00	20.50	1,800	500	20	10	Yes
Alpena, Mich.	12,706	M	4.00	2.00	2.00	.....	3.00	11.00	2,711	64	10	04	Yes
Ann Arbor, Mich.	14,817	P	3.50	3.00	3.00	.....	5.00	14.50	3,879	350	20	08	Yes
Battle Creek, Mich.	25,267	M	4.00	2.00	3.00	.....	4.00	13.00	5,920	5,769	13	06	No
Bay City, Mich.	45,166	M	.....	.....	.....	.....	.....	.....	5,620	2,212	.....	.....	No
Detroit, Mich.	465,766	M	3.20	1.00	1.60	0.50	1.40	7.70	103,487	10,807	05	03	No
Escanaba, Mich.	13,194	P	1.50	1.00	1.00	0.50	6.00	10.00	2,000	400	30	10	Yes
Flint, Mich.	38,550	M	.....	.....	.....	.....	.....	.....	5,306	2,149	20	05	No
Grand Rapids, Mich.	112,571	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Holland, Mich.	10,490				(All metered)				2,229	2,193	.....	.....	No

CITY	POPULATION, 1910	OWNERSHIP, WHETHER MUNICIPAL OR PRIVATE	SCHEDULE OF WATER RATES						NUMBER OF CONSUMERS	NUMBER OF METERS	METER RATE PER 1000 GALLONS		IS WATER TREATED
			House use 6 rooms	Bath	Closet	Wash stand and laundry tubs	Sprinkling 40 feet with privilege of sprinkling roadway	Total			Maximum	Minimum	
Ishpeming, Mich	12,448	M	4.50	1.50	1.50	.....	1.25	8.75	2,018	1,577	10	04	No
Jackson, Mich	31,433	M			(All metered)				6,200	6,175	.....	.....	No
Kalamazoo, Mich	39,437	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lansing, Mich	31,229	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ludington, Mich	9,132	M	6.00	2.00	3.00	1.50	6.00	18.50	1,800	1,600	10	10	No
Marquette, Mich	11,503	M	8.00	5.00	3.00	.....	7.00	23.00	2,050	1,010	13	04	Yes
Menominee, Mich	10,507	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Owosso, Mich	9,639	M			(All metered)				1,675	1,627	.....	.....	No
Saginaw, Mich	50,510	M	6.00	2.50	3.00	0.50	3.00	15.00	7,873	340	11	04	No
Traverse City, Mich	12,115	M	.....	.....	.....	.....	.....	.....	2,100	781	.....	.....	No
Duluth, Minn	78,466	M	6.50	2.00	2.00	2.00	5.00	17.50	11,588	6,552	23	.....	Yes
Minneapolis, Minn	301,408	M	.....	.....	.....	.....	.....	.....	48,000	42,000	.....	04	.....
St. Paul, Minn	214,744	M	3.80	2.00	3.00	.....	.....	8.80	33,129	19,584	08	.....	No
Stillwater, Minn	10,198	M	7.00	3.00	4.00	.....	2.00	16.00	1,000	None	.....	.....	No
Virginia, Minn	10,473	P	.....	.....	.....	.....	.....	16.00	1,800	200	46	16	No
Jackson, Miss	21,262	M	6.00	6.00	5.00	4.50	7.00	28.50	4,100	1,600	26	08	No
Meridian, Miss	23,285	M	.....	.....	.....	.....	.....	.....	3,663	2,200	.....	.....	Yes
Independence, Mo	9,859	P	7.00	2.00	2.25	.....	5.60	16.85	1,768	1,396	35	25	Yes
Kansas City, Mo	248,381	M	5.50	3.50	3.50	.....	7.50	20.00	53,000	25,269	25	07	Yes
Moberly, Mo	10,923	M	6.00	4.00	3.00	.....	.....	13.00	1,295	1,170	50	20	No
St. Joseph, Mo	77,403	P	4.50	3.00	3.00	.....	4.00	14.50	12,648	2,127	30	06	Yes
St. Louis, Mo	687,029	M	4.00	2.00	3.00	.....	1.75	10.75	109,624	7,366	25	08	Yes
Sedalia, Mo	17,822	P	6.00	5.00	5.00	.....	Meter only	16.00	1,993	705	30	10	Yes
Springfield, Mo	35,201	P	8.00	2.00	2.00	.....	5.00	17.00	6,900	1,300	25	10	Yes

Anaconda, Mont.	10,134	P							1,700	0			No
Billings, Mont.	10,031	P	10.00	4.00	4.00	3.00	6.50	27.50	2,100	360	33	13	No
Butte, Mont.	39,165	P							9,484	573			No
Missoula, Mont.	12,869	M	24.00	6.00	6.00		Permit only	36.00	2,450	150	34	14	No
Lincoln, Neb.	43,973												
Omaha, Neb.	124,096	M							23,807	20,593			Yes
Reno, Nevada	10,867												
Concord, N. H.	21,497	M	5.00	3.00	3.00	1.00	3.00	15.00	3,752	2,243	20	06	No
Dover, N. H.	13,247	M	6.00	5.00	5.00		5.00	21.00	1,931	1,438	30	20	Yes
Keene, N. H.	10,068	M	5.50	4.00	4.00		4.00	17.50	2,127	190	26	02	No
Manchester, N. H.	70,063	M	4.00	1.75	2.00	1.00	5.00	13.75	7,352	5,689	13	09	No
Bridgeton, N. J.	14,209	M	5.00	3.00	2.00	2.00	3.00	15.00	2,983	0	15	04	Yes
Camden, N. J.	94,538	M	5.00	3.00	3.00	2.00	3.00	16.00	20,471	1,131	20	10	No
Garfield, N. J.	10,213	M			(All metered)				1,425	1,300	40	14	No
Newark, N. J.	347,469	M	6.25	5.00	2.50		5.00	18.75	44,772	24,729	40	14	No
Passaic, N. J.	54,773	P	12.00				8.00	20.00	7,207	3,782	30	10	Yes
Paterson, N. J.	125,600	P							15,500	8,438	30	10	Yes
Perth Amboy, N. J.	32,121	M	6.00	4.00	3.00	1.00	4.00	18.00	4,000	1,366	15	05	No
Phillipsburg, N. J.	13,903	P							1,550	66			Yes
Rahway, N. J.	9,337	M	6.00	5.00	3.00		4.00	18.00	1,789	180	20	05	Yes
West Orange, N. J.	10,980	P			(All metered)				1,801	1,671	26	20	
Albuquerque, N. M.	11,020	P			(All metered)				2,478	2,478	35	20	No
Las Vegas, N. M.	3,179	P		8.00			12.50		1,600	12			No
Auburn, N. Y.	34,668	M	4.25	2.20	2.20	2.20	3.60	14.45	8,200	702	16	04	Yes
Binghamton, N. Y.	48,443	M	3.00	3.00	3.00	3.00	3.00	15.00	10,417	4,000	12	06	Yes
Buffalo, N. Y.	423,715	M	3.00	1.50	1.50		2.99	8.99	77,260	3,459	06	02	No
Cortland, N. Y.	11,504	M	6.00	3.00	4.00	4.00	7.50	24.50	2,400	1,640	40	20	No
Dunkirk, N. Y.	17,221	M			(All metered)				3,195	3,188	07	03	No
Elmira, N. Y.	37,176	P							7,712	3,559			Yes
Geneva, N. Y.	12,446	M			(All metered)				3,090	2,950	20	06	Yes
Glens Falls, N. Y.	15,243	M	5.00	3.00	4.00		3.00	15.00	3,372	89	16	03	No
Gloversville, N. Y.	20,642	M	4.00	2.00	2.00		Meter only	8.00	3,877	3,630	16	03	No
Jamestown, N. Y.	31,297	M	Metered when Flat Rate Exceeds					8.00	7,500	6,000	20	20	No
Kingston, N. Y.	25,908	M	4.00	4.00	3.00	1.50	2.00	14.50	5,275	125	16	06	Yes

CITY	POPULATION, 1910	OWNERSHIP, WHETHER MUNICIPAL OR PRIVATE	SCHEDULE OF WATER RATES						NUMBER OF CONSUMERS	NUMBER OF METERS	METER RATE PER 1000 GALLONS		IS WATER TREATED
			House use 6 rooms	Bath	Closet	Wash stand and laundry tubs	Sprinkling 40 feet with privilege of sprinkling roadway	Total			Maximum	Minimum	
Little Falls, N. Y.	12,273	M	3.00	2.50	2.00	2.00	2.50	12.00	2,102	331	21	03	No
Mount Vernon, N. Y.	30,919	P			(All metered)				6,021	5,000	40	13	Yes
New Rochelle, N. Y.	28,867	P			(All metered)				6,230	6,164	30	20	No
New York City, N. Y.	4,766,883	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Newburgh, N. Y.	27,805	M	8.00	0.50	0.50	.....	5.00	14.00	4,667	3	10	03	No
Niagara Falls, N. Y.	30,445	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Yes
N. Tonawanda, N. Y.	11,955	M	6.00	2.00	3.00	1.50	2.80	15.30	2,400	50	.....	.....	No
Ogdensburg, N. Y.	15,933	M	8.00	3.00	3.00	.....	6.00	20.00	3,379	10	.....	.....	Yes
Olean, N. Y.	14,743	M			(All metered)				2,877	2,877	13	05	No
Ossining, N. Y.	11,480	M	8.00	Meter	Meter	2.25	Meter	10.25	1,616	1,385	20	12	No
Peekskill, N. Y.	15,245	M			(All metered)				2,500	2,100	13	06	Yes
Poughkeepsie, N. Y.	27,936	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Rensselaer, N. Y.	10,711	P	6.00	3.00	3.00	2.75	5.00	19.75	1,850	140	20	10	Yes
Saratoga Springs, N. Y.	12,693	M			(All metered)				.....	.....	10	10	.....
Schenectady, N. Y.	72,826	M	4.00	1.50	1.50	.....	2.00	9.00	12,000	240	16	5	No
Troy, N. Y.	76,813	M	6.40	2.00	3.00	.....	8.00	19.40	11,462	400	5	5	No
Utica, N. Y.	74,419	P			(All metered)				12,588	12,411	30	6	.....
Waterford, N. Y.	3,245	P			(All metered)				.....	.....	20	8	No
Watertown, N. Y.	26,730	M	4.00	1.00	2.00	.....	3.00	10.00	5,000	690	20	3	Yes
White Plains, N. Y.	15,949	M			(All metered)				3,250	3,213	31	20	No
Yonkers, N. Y.	79,803	M			(All metered)				8,697	.....	16	8	Yes
Asheville, N. C.	18,762	M	.....	.....	.....	.....	.....	.....	3,500	2,500	.....	.....	.....
Durham, N. C.	18,241	P	.....	.....	.....	.....	.....	.....	3,150	1,350	25	18	Yes
Wilmington, N. C.	25,748	M	.....	.....	.....	.....	.....	.....	3,127	1,390	.....	.....	Yes
Grand Forks, N. D.	12,578	M	.....	.....	.....	.....	.....	.....	2,250	.....	50	12	Yes

Canton, Ohio	50,217	M	7.00	.....	.....	.....	1.00	.....	10,997	926	7	7	No
Cincinnati, Ohio	363,591	M	4.16	2.38	1.42	0.86	5.15	13.97	53,560	25,489	10	10	Yes
Columbus, Ohio	181,511	M	.....	.....	.....	.....	.....	.....	28,736	26,769	12	10	Yes
Cleveland, Ohio	560,663	M	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Elyria, Ohio	14,825	M			(All metered)				3,571	3,571	20	8	No
Fremont, Ohio	10,000	M			(All metered)				1,850	1,730	.....	.....	No
Marion, Ohio	18,232	P			(All metered)				2,150	2,100	25	6½	No
Massillon, Ohio	13,879	P	5.20	2.50	2.70	.....	4.95	15.35	3,262	1,000	20	12	No
Middletown, Ohio	13,152	M	4.40	2.75	.....	1.10	4.00	.....	2,720	1,450	14	8	No
Newark, Ohio	25,404	M	6.75	3.50	1.50	.....	6.00	17.75	3,500	2,300	18	10	No
Piqua, Ohio	13,388	M	4.00	2.00	2.00	.....	3.00	11.00	1,950	None	.....	.....	No
Springfield, Ohio	46,921	M	.....	.....	.....	.....	.....	.....	8,600	2,000	.....	.....	No
Tiffin, Ohio	11,894	P	5.00	3.00	3.50	.....	4.00	15.50	.....	.....	22	12	.....
Warren, Ohio	11,081	P	.....	.....	.....	.....	.....	.....	3,008	2,063	24	10	Yes
Youngstown, Ohio	79,066	M	5.28	2.64	2.64	.....	3.96	.....	14,500	4,161	16	8	Yes
Zanesville, Ohio	28,026	M	5.30	1.00	3.00	.....	2.00	11.30	8,000	50	6	6	Yes
Guthrie, Okla	11,654	M	5.00	3.00	6.00	.....	4.00	18.00	1,300	850	50	10	Yes
Muskogee, Okla	25,278	M	.....	.....	.....	.....	.....	.....	4,700	3,000	16	9	Yes
Oklahoma City, Okla	64,205	M	13.60	.....	.....	.....	6.00	19.60	10,604	7,350	20	10	Yes
Shawnee, Okla	12,474	M	.....	.....	.....	.....	.....	.....	1,900	1,400	.....	.....	Yes
Portland, Oregon	207,214	M	6.00	1.20	1.80	.....	7.00	16.00	54,481	13,221	22½	13	No
Allentown, Pa	51,913	M	7.50	2.50	4.00	1.00	8.50	23.50	13,179	11,730	53	08	No
Altoona, Pa	52,127	M	4.80	3.00	3.00	1.00	.....	.....	12,993	616	33	4	No
Bradford, Pa	14,544	.....	3.80	0.80	1.20	.....	3.00	8.80	3,883	116	6	4	No
Chester, Pa	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Erie, Pa	66,525	M	4.00	3.00	3.00	3.00	3.50	16.50	14,551	406	20	4	.....
Harrisburg, Pa	64,186	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wilkesbarre, Pa	67,105	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Johnstown, Pa	55,482	P	9.75	3.00	3.00	2.00	5.00	22.75	10,250	1,511	40	5	No
Lebanon, Pa	19,240	M	5.00	2.00	2.50	1.00	7.00	17.50	4,730	117	20	4½	No
McKeesport, Pa	42,694	M	8.00	7.50	7.50	.....	8.00	31.00	6,039	3,606	26	9	.....
Meadville, Pa	12,780	M	.....	.....	.....	.....	.....	.....	2,873	1,764	.....	.....	.....
Philadelphia, Pa	1,549,008	M	5.00	3.00	1.00	2.00	8.00	19.00	360,000	4,850	4	4	Yes
Pittsburgh, Pa	533,905	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Reading, Pa	96,071	M	4.50	2.50	2.00	.....	7.00	16.00	22,792	4,177	40	29	Yes
Sharon, Pa	15,270	P	6.00	5.00	5.00	4.00	10.00	30.00	4,037	1,354	35	10	Yes

CITY	POPULATION, 1910	OWNERSHIP, WHETHER MUNICIPAL OR PRIVATE	SCHEDULE OF WATER RATES						NUMBER OF CONSUMERS	NUMBER OF METERS	METER RATE PER 1000 GALLONS		IS WATER TREATED
			House use 6 rooms	Bath	Closet	Wash stand and laundry tubs	Sprinkling 40 feet with privilege of sprinkling roadway	Total			Maximum	Minimum	
Shenandoah, Pa	25,774	M	6.00	2.50	5.00	.....	1.00	14.50	3,800	25	20	8	No
Sunbury, Pa	13,770	.....	.....	.....	.....	.....	.....	.....	3,200	50	.....	.....	.....
Wilkinsburg, Pa	18,924	P			(All metered)				12,834	.....	.....	.....	Yes
Williamsport, Pa	31,860	P	5.70	4.75	1.90	1.90	5.70	19.95	6,925	115	10	.....	No
Pawtucket, R. I	.....	M	.....	.....	.....	.....	.....	.....	11,266	9,893	30	6	.....
Providence, R. I	224,326	M	6.00	5.00	5.00	5.00	5.00	26.00	29,261	26,298	20	10	Yes
Charleston, S. C	58,833	P	.....	.....	.....	.....	.....	.....	4,500	250	.....	.....	Yes
Columbia, S. C	26,319	M			(All metered)				3,120	3,120	15	8	Yes
Jackson, Tenn	15,779	M	7.00	3.00	6.00	.....	9.00	25.00	.....	.....	15	5	No
Memphis, Tenn	131,105	M	4.50	3.75	3.75	.....	7.50	19.50	22,831	12,451	24	10	No
Nashville, Tenn	110,364	M	9.00	4.00	5.00	.....	17.35	.....	16,729	13,320	20	8	.....
Denison, Texas	13,632	M	.....	.....	.....	.....	.....	.....	3,000	2,600	50	7	.....
El Paso, Texas	39,279	M	.....	.....	.....	.....	.....	.....	5,960	4,673	.....	.....	.....
Galveston, Texas	36,981	M			(All metered)				6,041	6,041	26	9	No
Laredo, Texas	14,855	P	.....	.....	.....	.....	.....	.....	1,235	300	16	13	Yes
San Antonio, Texas	96,614	P	5.00	4.50	3.00	.....	.....	.....	20,000	4,542	15	9	No
Temple, Texas	10,993	M	15.00	6.00	6.00	.....	.....	.....	1,900	855	25	10	Yes
Waco, Texas	26,425	M	7.00	5.00	3.00	6.00	9.60	30.60	8,758	650	30	15	No
Ogden, Utah	25,580	M	6.50	1.00	1.50	1.50	22.78	.....	5,600	325	20	05	.....
Salt Lake City, Utah	92,777	M	4.75	1.00	2.00	3.00	13.35	28.10	17,564	800	7	06	No
Burlington, Vt	20,468	M	6.00	4.00	4.00	.....	8.00	22.00	4,009	3,503	20	08	Yes
Rutland, Vt	13,546	M	5.00	2.00	2.00	.....	.....	.....	2,879	150	8	04	No
Lynchburg, Va	29,494	M	6.00	3.00	3.00	.....	3.00	.....	5,800	475	20	03	No
Richmond, Va	127,628	M	4.00	3.50	3.00	.....	8.80	19.30	26,000	18,739	14	05	Yes
Roanoke, Va	34,874	P	9.00	3.00	3.00	5.00	5.00	25.00	6,898	3,483	25	15	No

North Yakima ,Wash	14,082	P	.....	.....	.....	.....	.....	.....	3,085	3,226	20	07	.....
Seattle, Wash	237,194	M	7.80	2.40	2.40	.....	.....	.....	41,163	31,890	6	05	No
Spokane, Wash	104,402	M	12.00	2.40	2.40	.....	2.40	.....	20,606	7,690	10	.....	No
Tacoma, Wash	83,743	M	.....	.....	.....	.....	.....	.....	13,919	1,357	.....	.....	No
Walla Walla, Wash	19,364	M	12.00	3.00	3.00	.....	11.10	.....	3,659	182	20	08	No
Ashland, Wis	11,594	P	9.00	5.00	4.00	.....	5.00	23.00	1,978	543	.....	.....	Yes
Beloit, Wis	15,125	P	.....	.....	.....	.....	.....	.....	2,170	1,765	10	02	No
Green Bay, Wis	25,236	P			(All metered)				3,623	.....	21	13	No
La Crosse, Wis	30,417	M	5.00	2.00	3.00	2.00	5.00	17.00	5,300	2,470	20	04	No
Madison, Wis	25,531	M			(All metered)				5,504	5,453	.....	.....	No
Marinette, Wis	14,610	P	6.00	3.00	2.50	.....	5.00	.....	2,798	97	30	15	Yes
Milwaukee, Wis	373,857	M	6.00	3.00	2.00	1.00 1.00	10.00 6.25	.....	58,357	57,657	8	06	.....
Racine, Wis	38,002	P	4.80	3.60	4.00	.....	4.80	17.20	7,662	5,574	28½	06	No
Superior, Wis	40,384	P	5.89	3.68	4.05	2.94	.....	.....	5,056	4,408	40	8.7	Yes
Cheyenne, Wyoming	11,320	M	6.00	5.00	5.00	.....	5.00	.....	2,000	1	6	02	.....

	TOTAL FOR FAMILY USE, HOUSE OF 6 ROOMS, INCLUDING BATH, CLOSET, SPRINKLING ROADWAY AND LAWN NOT OVER 40 FEET FRONTAGE	METER RATES	
		Maximum per 1000 gallons	Minimum per 1000 gallons
Rates in 307 cities where water is supplied by private company or municipal plant	18.08	0.23	0.09
Rate in cities where water is supplied by private company	19.89	0.28	0.10½
Rate in cities where treated water is supplied by private company	18.53	0.29½	0.09 5/10
Rate in cities having population between 100,000 and 300,000	18.40	0.20	0.08½
Rate in cities where treated water is supplied either by private company or municipal plant	18.17	0.23	0.09
Rate in cities where water is being supplied by municipal plant	17.49	0.18	0.09
Rate in cities supplied with untreated water	17.95	0.20	0.08½

Information relative to distribution system

CITY	POPULATION 1910	MILEAGE OF PIPE IN SYSTEM 1913	PERCENTAGE VARIOUS SIZES OF PIPE IN SYSTEM					NUMBER FIRE HYDRANTS IN SYSTEM	PUBLIC DRINKING FOUNTAINS	AVERAGE NUMBER HYDRANTS PER MILE OF PIPE	NUMBER OF TAPS IN SERVICE	PERCENTAGE OF TOTAL POPULATION SUPPLIED	AVERAGE NUMBER TAPS PER MILE OF PIPE	PERCENTAGE OF TOTAL PUMPAGE FURNISHED AS "FREE WATER" TO CITY
			4" or smaller	6"	8"	10"	12" and larger							
Anniston, Ala.	12,794	26.0+	23.0	20.0	5.0	3.0	49.0	130	1	5	1,600	60	60	No estimate
Mobile, Ala.	51,521	157.6	24.8	50.7	6.2	2.3	16.0	974	41	6	11,769	90	73	14 per cent
Phoenix, Ariz.	11,134	67.0	42.5	45.8	5.8	3.5	2.4	280	10	4	4,100	98	61	20 per cent
Pine Bluffs, Ark.	15,102	38.0	12.0	52.4	15.3	7.5	12.8	312	5	8	2,077	60	54	Very small percentage
Sacramento, Cal.	44,696	40.0	6.0	51.9	5.3	8.8	28.0	560	25	.....	12,800	75	.....	All city service; no estimate
San Francisco, Cal.	416,912	581.0	38.6	18.6	23.6	0.2	19.0	4,421	7	7	61,721	99	106	No free service
Colorado Springs, Col.	29,078	143.0	38.5	22.9	6.9	5.5	26.2	504	31	3	11,858	98	83	40 per cent
Denver, Col.	213,381	516.0	8.3	41.6	6.8	3.0	40.3	3,272	69	6	43,819	99	85	8 per cent
Bristol, Conn	13,502	40.0	30.5	30.7	14.0	7.8	17.0	130	1	3	1,848	80	46	0.5 of 1 per cent
Hartford, Conn	98,915	180.0	8.8	46.6	11.9	4.8	27.9	1,367	14	7	13,278	.....	73	No estimate
New Haven, Conn.	133,605	173.0	2.9	39.7	28.8	10.9	17.7	1,000	25	5	.....	.....	.....	No estimate
Wilmington, Del.	87,411	134.0	27.5	18.4	34.0	0.8	19.3	935	28	7	19,331	98	144	No estimate
Washington, D. C.	331,069	428.0	8.2	47.5	23.7	0.3	20.3	3,111	224	7	67,790	.....	158	No estimate
Jacksonville, Fla.	57,699	60.0	2.3	67.6	12.5	8.8	8.8	700	30	11	9,270	70	154	No free service
Tampa, Fla.	37,782	60.0	15.1	40.4	20.8	10.8	12.9	603	8	10	6,495	75	108	No free service
Macon, Ga.	40,665	75.0	15.5	48.4	6.9	7.1	22.1	497	16	6	5,370	75	71	No free service
Atlanta Ga.	154,839	309.0	2.0	61.4	15.3	4.2	17.1	2,929	.....	9	25,434	85	72	30 per cent
Freeport, Ill.	17,567	41.0	48.2	42.9	6.0	1.7	1.2	200	4	5	3,484	.....	85	No estimate
Peoria, Ill.	66,950	111.0	24.0	33.9	13.8	10.9	17.4	1,376	20	12	10,700	58	96	10 per cent
Springfield, Ill	51,678	74.0	18.0	63.5	None	0.3	18.2	863	32	11	6,049	48	81	No estimate
Aurora, Ill	29,807	79.0	8.5	80.8	4.4	1.5	4.8	609	4	7	5,802	75	73	20 to 25 per cent
Chicago, Ill	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Decatur, Ill.	31,140	71.0	5.6	74.0	2.7	2.7	15.0	614	5	8	5,300	95	74	1 per cent
Elgin, Ill.	25,976	58.0	3.5	69.2	14.4	3.6	9.3	483	5	8	5,051	82	87	No free service
Elkhart, Ind.	19,282	49.0	3.3	74.0	7.5	4.2	11.0	343	8	7	3,979	70	81	No estimate
Indianapolis, Ind.	233,650	349.0	6.0	49.0	21.0	4.0	20.0	2,971	.....	8	30,753	68	88	.....
Evansville, Ind.	69,647	110.0	17.0	55.9	9.3	1.7	16.1	734	6	7	8,600	70	78	No estimate
Ft. Wayne, Ind.	63,933	119.0	8.8	65.8	10.0	0.8	14.6	925	25	7	13,500	95	113	No estimate
La Fayette, Ind.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Marion, Ind.	19,359	41.0	14.8	76.3	3.0	4.2	1.7	346	18	8	3,680	75	89	No estimate
Terre Haute, Ind.	58,157	89.0	7.7	28.8	40.9	3.2	19.4	1,078	22	12	5,960	60	67	No free service
Council Bluffs, Ia.	29,292	57.0	57.5	23.4	7.9	0.3	10.9	362	2	6	5,500	66	96	5 per cent
Iowa City, Iowa.	10,091	21.0	27.7	58.5	8.5	3.8	1.5	208	3	9	1,415	75	67	2 per cent
Sioux City, Iowa.	47,828	76.0	4.9	54.5	18.5	3.8	18.3	476	10	6	6,200	.....	81	All city service; no estimate
Atchison, Kan.	16,429	32.0	39.3	20.7	17.1	12.5	10.4	182	(11 Horse troughs)	5	2,405	60	75	10 per cent
Pittsburg, Kan.	14,755	39.0	29.1	48.0	10.0	1.1	11.8	254	.....	6	3,817	90	92	No free service
Frankfort, Ky	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Louisville, Ky.	223,928	375.0	16.7	54.0	9.3	0.5	19.5	1,955	.....	5	33,733	90	89	No estimate
Lexington, Ky.	35,099	75.0	25.8	46.8	13.1	5.5	8.8	605	8	8	5,130	70	68	2 per cent
New Orleans, La.	339,075	528.0	31.4	46.4	2.3	0.2	19.7	5,103	12	9	33,959	71	64	24.5 per cent
Portland, Me.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Baltimore, Md.	558,485	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Beverly, Mass.	18,650	80.0	.....	.....	.....	.....	.....	469	14	5	4,405	100	55	10 to 15 per cent
Boston, Mass.	670,585	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cambridge, Mass.	104,839	136.0	.....	.....	.....	.....	.....	1,125	30	8	16,194	100	119	32 per cent
Everett, Mass.	33,484	49.0	14.6	53.3	8.8	16.3	7.0	559	4	11	5,660	99	115	No estimate
Fall River, Mass.	119,295	118.0	.....	40.9	27.1	8.4	23.6	1,408	21	12	8,988	99	76	28.3 per cent
Gloucester, Mass.	24,398	72.0	34.6	27.7	8.3	7.2	22.2	329	11	4	4,771	90	66	30 per cent
Lowell, Mass.	106,294	150.0	4.6	59.3	19.0	4.1	13.0	1,283	28	8	12,952	100	86	No estimate
Lynn, Mass.	89,336	150.0	.....	.....	.....	.....	.....	1,186	17	7	15,962	100	106	No estimate
Waltham, Mass.	27,834	56.0	23.2	39.0	21.6	3.8	12.4	476	2	8	3,996	.....	71	No estimate
Ann Arbor, Mich.	14,817	40.0	9.2	73.0	5.4	1.4	11.0	258	2	6	3,879	80	97	No free service
Bay City, Mich.	45,166	97.0	6.9	61.1	11.9	8.5	11.6	892	19	9	5,620	75	58	25 per cent
Detroit, Mich.	465,766	840.0	19.2	47.8	14.7	5.4	12.9	5,849	123	7	103,487	99.9	123	8 per cent
Flint, Mich.	38,550	60.0	32.9	32.2	12.1	.....	22.8	342	.....	5	5,306	.....	88	No estimate

Information relative to distribution system—Continued

CITY	POPULATION 1910	MILEAGE OF PIPE IN SYSTEM 1913	PERCENTAGE VARIOUS SIZES OF PIPE IN SYSTEM					NUMBER FIRE HYDRANTS IN SYSTEM	PUBLIC DRINKING FOUNTAINS	AVERAGE NUMBER HYDRANTS PER MILE OF PIPE	NUMBER OF TAPS IN SERVICE	PERCENTAGE OF TOTAL POPULATION SUPPLIED	AVERAGE NUMBER TAPS PER MILE OF PIPE	PERCENTAGE OF TOTAL PUMPAGE FURNISHED AS "FREE WATER" TO CITY
			4" or smaller	6"	8"	10"	12" and larger							
Grand Rapids, Mich.														
Jackson, Mich.	31,433	87.0	41.5	44.4	3.9	5.7	4.5	694	22	8	6,200	80	71	All city water free
Lansing, Mich.														
Saginaw, Mich.	50,510	116.0	7.4	64.6	9.0	8.5	10.5	947	42 W. T.	8	7,873	53	68	No estimate
Traverse City, Mich.	12,115	28.0	8.8	72.1	4.7	5.3	9.1	262	5	9	2,100	66	75	No estimate
Duluth, Minn.	78,466	142.0	1.6	58.6	5.6	8.4	25.8	959	(17 H.T. 12)	6	11,588	75	82	No estimate
Minneapolis, Minn.	301,408	496.0	None	58.1	15.1	0.6	26.2	5,059	None	10	48,000	95	97	10 per cent
St. Paul, Minn.	214,744	360.0	3.7	64.9	1.4	None	30.0	3,293	.....	9	33,129	.....	92	No estimate
Stillwater, Minn.	10,198	13.0	4.0	51.1	34.3	2.4	8.2	151	(7 H.T. and 2)	11	1,000	33⅓	77	Small amount
Jackson, Miss.	21,262	32.0	4.6	49.9	2.3	21.8	21.4	510	12	16	4,100	90	128	3 per cent
Meridian, Miss.	23,285	42.0	26.7	35.5	14.7	10.4	3.0	400	16	9	3,663	72	87	No free water
Yazoo City	6,796	15.0	15.4	61.2	10.4	3.1	9.9	167	(4 W.T. and 1)	11	1,173	90	78	No estimate
Kansas City, Mo.	248,381	490.0	6.9	56.1	14.2	6.7	16.1	6,000	56	12	53,000	95	108	20 per cent
St. Louis, Mo.	687,029	949.0	1.9	60.0	1.6	1.0	.....	11,103	493	11	109,624	99.9	115	25 per cent
Butte, Mont.	39,165	98.0	27.3	40.1	11.8	6.7	14.1	522	5	5	9,484	100	97	.....
Omaha, Neb.	124,096	249.0	4.1	43.4	22.6	5.9	24.0	2,047	105	8	23,807	80	95	7 per cent
Concord, N. H.	21,497	69.0	13.5	33.9	9.8	13.2	29.6	430	(13 W.T. and 4)	6	3,752	94	54	Small per cent
Manchester, N. H.	70,063	131.0	3.0	56.9	17.3	7.3	15.5	941	10	7	7,352	90	56	No estimate
Camden, N. J.	94,538	99.0	17.5	52.7	17.2	1.9	10.7	897	17	9	20,471	86	206	No estimate

Newark, N. J.....	347,469	405.0	7.1	58.5	4.4	3.8	26.2	3,048	88	7	44,772	100	110	No estimate
Las Vegas, N. M...	3,179	13.0	77.1	7.8	15.1	None	None	63	2	5	1,600	100	123	No estimate
Buffalo, N. Y.....	423,715	553.0	7.0	58.4	0.6	7.0	27.0	5,210	46	9	77,260	100	139	Less than 1 per cent
Elmira, N. Y	37,176	95.0	12.7	54.7	16.8	6.1	9.7	513	(6 H.T.)	5	7,712	99.9	81	No free service
Glens Falls, N. Y..	15,243	37.0	35.2	46.3	3.7	7.8	7.0	332	None	9	3,372	100	91	No estimate
Columbus, O.....	181,511	303.0	8.1	55.1	21.2	0.1	15.5	2,101	6	7	28,736	94	95	5 per cent
Marion, O.....	18,232	35.0	10.0	60.0	17.1	1.7	11.2	430	(1 and 5 H.T.)	12	2,150	60	61	2½ million
Massillon, O.....	13,879	36.0	27.3	61.5	4.2	2.8	4.2	309	(3 and 6 H.T.)	8	3,262	98	90	No estimate
Newark, O.....	25,404	77.0	2.4	62.3	10.3	5.9	19.1	711	(7 and 9 H.T.)	9	3,500	40	45	5 per cent
Piqua, O.....	13,388	23.0	35.7	54.5	5.4	1.2	3.2	260	(6 W. T.)	11	1,950	.....	85	7½ per cent
Springfield, O.....	46,921	108.0	9.3	48.8	10.0	2.6	29.3	725	10	7	8,600	90	79	10 per cent
Warren, O.....	11,081	34.0	11.4	69.5	13.5	3.0	2.6	179	11	5	3,008	100	88	.....
Youngstown, O	79,066	148.0	2.4	50.6	28.0	0.3	18.7	1,490	8	10	14,500	87	98	30 per cent
Guthrie, Okla.....	11,654	21.0	28.5	47.6	9.6	9.6	4.7	130	10	6	1,300	50	62	No estimate
Oklahoma City Okla.....	64,205	148.0	9.8	74.87	2.0	7.21	6.12	795	12	5	10,604	75	71	5 per cent
Portland, Ore	207,214	455.0	10.55	26.15	40.5	4.2	18.6	4,007	75	9	54,481	100	119	Unknown
Allentown, Pa.....	51,913	74.0	15.77	36.10	21.43	1.8	24.9	537	30	7	13,179	100	178	No estimate
Altoona, Pa.....	52,127	84.0	7.8	29.7	25.6	None	36.9	774	4	9	12,993	99	154	No estimate
Bradford, Pa.....	14,544	37.0	15.8	43.9	6.9	2.1	31.3	282	4	7	3,883	95	105	No estimate
Erie, Pa.....	66,525	145.0	20.4	57.4	0.4	None	21.8	918	35	6	14,551	100	100	No estimate
Johnstown, Pa	55,482	110.0	37.9	19.5	3.9	1.4	37.3	232	5	2	10,250	(75–80)	93	Very small per cent
McKeesport, Pa....	42,694	66.0	46.4	30.6	8.7	0.7	13.6	472	2	7	6,039	75	91	20 per cent
Philadelphia, Pa ...	1,549,008	1,718.0	1.7	65.6	5.4	6.0	21.3	16,942	.....	9	360,000	100	210	5 per cent
Reading, Pa.....	96,071	114.0	8.9	44.9	2.4	10.7	33.1	982	6	8	22,792	99.9	199	.....
Providence, R. I...	224,326	403.0	None	66.8	15.8	0.8	16.6	2,445	.....	6	29,261	100	72	No estimate
Charleston, S. C ...	58,833	57.0	3.0	55.8	10.4	1.8	29.0	628	40	11	4,500	45	79	No estimate
Columbia, S. C	26,319	42.0	1.8	58.0	12.5	4.3	23.4	309	8	7	3,120	95	74	2 per cent
Memphis, Tenn....	131,105	249.0	9.9	57.3	5.6	6.2	21.0	1,522	30	6	22,831	.....	92	20 per cent
Nashville, Tenn ...	110,364	168.0	5.0	31.2	2.5	0.1	61.2	1,420	18	8	16,729	.....	99	10 per cent
Denison, Texas	13,632	19.0	45.0	36.0	5.4	2.8	10.8	171	7	9	3,000	85	158	25 per cent

Information relative to distribution system—Continued

CITY	POPULATION 1910	MILEAGE OF PIPE IN SYSTEM 1913	PERCENTAGE VARIOUS SIZES OF PIPE IN SYSTEM					NUMBER FIRE HYDRANTS IN SYSTEM	PUBLIC DRINKING FOUNTAINS	AVERAGE NUMBER HYDRANTS PER MILE OF PIPE	NUMBER OF TAPS IN SERVICE	PERCENTAGE OF TOTAL POPULATION SUPPLIED	AVERAGE NUMBER TAPS PER MILE OF PIPE	PERCENTAGE OF TOTAL PUMPAGE FURNISHED AS "FREE WATER" TO CITY
			4" or smaller	6"	8"	10"	12" and larger							
El Paso, Texas	39,279	46.0	None	61.6	17.6	9.2	11.6	203	6	4	5,960	100	129	No free water
Laredo, Texas	14,855	20.0	41.2	12.1	36.1	7.0	3.6	135	4	6	1,235	100	62	5 per cent
San Antonio, Texas	96,614	200.0	31.9	33.7	18.2	7.0	9.2	1,341	3	7	20,000	90	100	25 per cent
Salt Lake City, Utah	92,777	209.0	12.7	69.6	6.4	2.1	9.2	1,725	48	8	17,564	95	84	20 per cent
Rutland, Vt.	13,546	22.0	10.2	70.8	10.2	None	8.8	169	1	7	2,879	93½	130	No estimate
Lynchburg, Va.	29,494	91.0	32.9	19.7	11.8	4.4	31.2	425	8	5	5,800	.....	63	No estimate
Richmond, Va	127,628	175.0	22.7	47.5	6.4	3.6	19.8	1,239	32	7	26,000	90	148	15 per cent
Roanoke, Va.	34,874	74.0	46.7	33.8	6.0	4.7	8.8	287	2	4	6,898	80	93	No estimate
Seattle, Wash.	237,194	550.0	16.9	14.2	46.7	3.6	18.6	5,108	.....	9	41,163	95	75	No estimate
Spokane, Wash.	104,402	367.0	3.6	65.7	6.2	4.9	19.6	2,142	3	6	20,606	95	56	None given
Beloit, Wis.	15,125	26.0	20.9	53.2	12.1	9.8	4.0	207	9	7	2,170	65	83	None given
Green Bay, Wis.	25,236	57.0	17.0	54.5	7.4	11.1	10.0	416	9	7	3,623	87	63	None given
Milwaukee, Wis.	373,857	696.0	0.7	69.8	12.7	None	16.8	3,340	108	5	58,357	100	83	None given
Cheyenne, Wyo.	11,320	30.0	54.0	19.8	8.3	1.3	16.6	164	6	5	2,000	99	67	No estimate
Averages	112,609	171.0	17.51	49.54	12.13	4.34	16.48	1,403	.....	8	18,571	85	93	.....

Some characteristic remarks concerning "Free Water"

"Water for public use should be charged and paid for by the department that uses it, both as a matter of equity and to restrict a lavish use of water."

"The free list is the thief that robs and undermines any business, and it cannot be maintained without deviation and discrimination, and should be eliminated."

"Free service should be metered and a maximum quantity fixed."

"It's a rotten steal—should be paid for, and let every one benefited by fire protection, street sprinkling, horse fountains, etc., help pay for same by tax, at the net cost of pumpage—under present system actual subscribers *only* pay for everything."

"It seems to be an inherited evil which can be guarded by metering and fixing the exact amount to be given."

"I believe that no service should be free as it tends to waste."

"It is an evil once started hard to control and bound to grow."

"I cannot accept the term 'free water;' *somebody must pay the bill.*"

"In order to give an accurate report on the earnings and losses of the department, the city should pay a reasonable amount for these services, and place same in the tax levy, for only in this way would the non-users pay their proportionate share of cost on benefits derived by them from fire and other services."

"I think it is dead wrong policy and adds to the burden of the consumer, making him pay in a slight way a double tax for the city expenses simply because he happens to be a water consumer; property owners, not water consumers, pay no part of this particular portion of the city expense."

"Cut out free water and assess a tax to overcome it."

"It is an abomination unto the Lord, and the mill stone that drags down efficiency in many small plants in this country."

"I am of opinion that free service is a misnomer. Water used under pressure costs something, and if not paid for directly in cash by the immediate consumer, must be provided for in some other way."

"As a matter of strict business practice, there can be no doubt of the fact that every service performed by the water works department should have proper accounting and remuneration, whether the money for such service is actually paid over or not."

CITY	INFORMATION RELATIVE TO ELECTROLYTIC ACTION ON PIPES AND SERVICE LINES	PROVISIONS RELATIVE TO ADDITIONS TO DISTRIBUTION SYSTEM
Anniston, Ala.	Some trouble. Remedied by Electro company	One hydrant to each 500 feet of mains ordered. No other requirement
Bessemer, Ala.	Lines not affected	Just return on investment
Phoenix, Ariz.	Services are affected. Company has insulated all service pipes with fiber conduit. Traction company rebonded all rails. No reimbursement to city on account of loss	No special requirements. Mains extended on application of citizens
Ft. Smith, Ark.	No particular trouble from electrolysis	.....
Pine Bluff, Ark.	Lines not affected	Requirement of $80 revenue for each 500 feet of water mains extended
Sacramento, Cal.	Mains slightly affected	.....
Pomona, Cal.	Lines not affected	Applicants pay cost of extension and receive all payments for water until amount is refunded
San Diego, Cal.	Mains affected to point of breaking. Traction line not reimbursing city for loss	Large mains laid by bond issue. Smaller mains out of department receipts
San Francisco, Cal.	Mains affected. Traction company bonding. No reimbursement for loss	.....
Stockton, Cal.	Mains slightly affected. Traction company attempting to prevent damage	Mains extended 100 feet for each consumer
Reedley, Cal.	Mains not affected. Light company has taken every precaution	Mains laid on guarantee of 7 per cent
Denver, Col.	Mains not affected. Traction company taking measures to prevent	Mains extended by special ordinances
Bristol, Conn.	No knowledge of any injury	Lines extended when revenue gives fair returns on investment
Hartford, Conn.	Mains affected, but extent of damage unknown. Traction company attempting to prevent injury	Mains extended upon a guarantee of 10 per cent return on cost
Manchester, Conn.	Mains affected very little. Traction company attempting to prevent injury	Mains extended when income warrants extension
New Britain, Conn.	Mains affected; services slightly affected. Traction company has attempted to prevent injury	Mains extended on 8 per cent of cost of investment
New Haven, Conn.	Mains affected somewhat. Traction company has attempted to prevent damage and has reimbursed company for some loss	Mains extended on application
New London, Conn.	Service lines slightly affected. Traction company doing nothing to prevent damage	Extensions made on guarantee of 5 per cent of cost of line

Stamford, Conn.	No trouble to speak of from electrolysis	Mains extended when receipts equal 10 per cent of cost of line
Wilmington, Del.	Mains affected to the extent that pipes had to be relaid. Traction company has made no effort to prevent damage. Water department has been reimbursed by Traction company when suit was threatened. Doubtful cases compromised	Mains extended on application
Washington, D. C.	Mains and service lines not seriously affected. All traction lines equipped with underground trolleys, metallic circuits	Mains laid only on bona fide need of water for existing houses when sewerage is provided and street has been graded. Flat assessment of $1.25 per linear foot on each lot abutting new main. Average revenue of this source past five years $83,293.64
Tampa, Fla.	Injury not serious at this time	Mains extended on order from city. One fire plug for each 400 feet
Athens, Ga.	Mains affected to small degree. Railway company renews all pipes affected at no cost to city	Mains extended on application of consumer
Atlanta, Ga.	Mains and service lines are affected. Traction lines are cooperating with water department and city electrician in an effort to remedy trouble	Mains extended whenever demand for water for domestic use and fire protection warrant expenditure
Macon, Ga.	Mains and services affected to a considerable degree. Traction lines doing nothing to prevent injury	Mains extended where the customs warrant expenditure
Anderson, Ind.	Slight damage to service pipes. Traction line attempting to prevent injury	Require 6 services to block
Elkhart, Ind.	No noticeable trouble	Mains extended on order from city. One hydrant for each 500 feet
Evansville, Ind.	Mains slightly affected. Service lines somewhat more. Traction company paid few small bills under protest	Ordinarily when revenue equals 20 per cent of cost of addition
Ft. Wayne, Ind.	Service pipes affected to great extent at times. Under franchise agreement, Traction company must pay for all damages to water pipes on account of electrolysis	When number of consumers warrants extension
Gary, Ind.	No noticeable effect	When income equals 10 per cent of cost of line
Hammond, Ind.	No noticeable effect	When revenue equals 6 per cent of cost of line
Indianapolis, Ind	Lines affected in locality of power plant. Traction lines making attempt to prevent this injury	Under franchise city has authority to order 40,000 feet of mains per year, taking one hydrant for each 500 feet so ordered
Logansport, Ind.	Lines affected somewhat. Traction company making some effort to prevent damage	When revenue equals 6 per cent of cost of mains
Marion, Ind.	Damage not serious. Traction line bonding	Whenever revenue justifies extension
New Castle, Ind.	No knowledge of any damage	Mains extended on guarantee of 10 per cent of cost of line

CITY	INFORMATION RELATIVE TO ELECTROLYTIC ACTION ON PIPES AND SERVICE LINES	PROVISIONS RELATIVE TO ADDITIONS TO DISTRIBUTION SYSTEM
Richmond, Ind	Mains not affected. Services in certain districts affected and replaced. Traction line rebonded in these districts and made one payment covering cost of replacement	Mains laid on orders from city where revenue to each 500 feet equals $49 from domestic use, or city takes one hydrant at $49
South Bend, Ind	Damage not considered serious. Traction company has rebonded their tracks	Lines usually laid where revenue equals 10 per cent of cost of line
Terre Haute, Ind	Mains and services affected. On complaint of water company, the Traction lines have gone over some of their bonds. Water company was reimbursed for damages to services when Stone and Webster controlled the railway lines but present Traction company refuses to recognize any liability	Mains are laid on orders from city with one fire hydrant for each 365 feet. Company lays voluntarily when consumption is $50 for each 365 feet
Burlington, Iowa	.....	Ordinance requires laying of 2 miles of pipe each year provided revenue equals 6 per cent of cost
Council Bluffs, Iowa	Damage not noticeable	Mains laid under printed contract with consumers with requirement of one consumer to every 50 feet
Davenport, Iowa	No noticeable damage	Mains laid on order of city council with provision for one fire hydrant and 6 consumers to each 400 feet
Des Moines, Iowa	Lines not affected	Additions made on order of city council with requirement of 2 miles per year
Dubuque, Iowa	No trouble from electrolysis	Extensions made when petitions pay 15 per cent annually on cost of mains
Iowa City, Iowa	No trouble from electrolysis	Additions made on order from city council with one hydrant at least $12 to each 400 feet
Keokuk, Iowa	No trouble from electrolysis	Additions made on one hydrant for every 732 feet or 5 consumers for each 366 feet
Ottumwa, Iowa	Mains and services badly affected in business districts. Traction company recently rebonded entire city	.....
Sioux City, Iowa	Some damage. Traction company doing nothing	Lines laid when revenue equals 10 per cent of cost
Waterloo, Iowa	Mains are being affected. Traction company attempting to remedy trouble	Extensions made where petitioners guarantee 15 per cent on cost for five years
Atchison, Kan	Damage not especially noticeable	Contract requirement extensions at least one consumer to each 100 feet
Ft. Scott, Kan	Damage not especially noticeable	Contract requirement extensions at least one consumer to each 100 feet

Hutchinson, Kan	Damage not noticeable	Extensions made for 6 consumers and one fire hydrant for each 450 feet
Parsons, Kan	Damage not noticeable	Mains are extended with provision of one hydrant each 600 feet
Pittsburg, Kan	Slight damage noticeable	Extensions made on guarantee of 10 per cent on cost
Withata, Kan	Slight damage noticeable	Extensions made on order from city with one fire hydrant for each 600 feet
Lexington, Ky	Mains and service lines slightly affected. Traction company pays cost of renewal	Mains laid on orders from city with hydrant for each 400 feet, or by payment of cost of line which is rebated from service within limit of eight years
Louisville, Ky	No trouble from electrolysis	Mains laid whenever revenue equals 10 per cent of cost of lines
Newport, Ky	Some damage, estimated at about $5,000.00	Additions made when revenue equals 8 per cent of cost
Alexandria, La	Systems not materially affected	Extensions made wherever revenue, etc., justifies
New Orleans, La	Heavy damage from electrolysis. Have renewed a number of lines since present system was completed in 1909. Traction company has taken no adequate steps to prevent loss and water department will probably bring suit	Extensions made where revenue equals 6 per cent of cost of line
Brunswick, Me	Some service pipes damaged. Traction company have bonded their rails and paid for renewing service pipes	Extensions are made where revenue equals 10 per cent of cost of line
Hagerstown, Md	No noticeable damage	Extensions made on request of mayor with provision for one hydrant for each 500 feet
Beverly, Mass	Services have been affected slightly. Railroad company has reimbursed city for expense incurred in renewing all damaged services	Extensions are made whenever the revenue justifies the line
Boston, Mass	Serious damage to system in vicinity of several street railway power houses. Necessary to relay some lines. Traction company attempting to remedy trouble	
Brookline, Mass	No noticeable damage	Extensions are made where revenue equals 5 per cent of cost of main
Clinton, Mass	No noticeable loss	Extensions made on vote of Water Commissioners
Everett, Mass	Slight damage to system	Extensions are made where revenue or deposit equals 6 per cent of cost of main
Fall River, Mass	No noticeable damage	Ordinance allows city to order 25,000 feet per year
Framingham, Mass	No apparent damage	Extensions made by board, usual requirement of 8 per cent of cost

CITY	INFORMATION RELATIVE TO ELECTROLYTIC ACTION ON PIPES AND SERVICE LINES	PROVISIONS RELATIVE TO ADDITIONS TO DISTRIBUTION SYSTEM
Gloucester, Mass	Service lines damaged. Necessary to replace 15 to 18 services each year. Traction company has paid actual cost of relaying pipe	Extensions made on vote of water commissioners
Haverhill, Mass	System slightly affected. Traction lines bonded	Lines extended whenever consumers justify extension
Lynn, Mass	No apparent damage	Extensions made on guarantee of 5 per cent of cost
Malden, Mass	System slightly damaged	Extensions made on guarantee of 7 per cent of cost of main
New Bedford, Mass	Damage to city very slight. Apparent damage to steel force main outside city. Local Electric Light & Traction Company carried on an investigation and did immense amount of work in installing return wires, etc.	Extensions made whenever revenue equals 6 per cent of cost of main
North Hampton, Mass	Occasional leaky services indicating presence of electrolysis	Additions are made on guarantee of 7 per cent on cost of line
Somerville, Mass	Mains not affected to any appreciable extent. Bonding is carefully done	Extensions are made whenever revenue justifies laying of main
Springfield, Mass	System damaged to some extent. Traction company cooperating in effort to eliminate trouble	Mains extended on guarantee equivalent to 15 cents annually per foot of pipe
Adrian, Mich	No damage noticeable. Rails well bonded	Additions made on basis of one consumer per 100 feet and one hydrant per 600 feet of pipe
Ann Arbor, Mich	No noticeable damage. Traction company has attempted to eliminate any danger	Additions made on orders from city with one hydrant to each 700 feet of pipe
Battle Creek, Mich	System has been damaged to approximate extent of $4,000. Traction company doing very little to prevent a continuance of damage	Mains are laid on guarantee of 7 per cent on an estimated cost of $1.00 per foot
Bay City, Mich	System not appreciably affected. Traction company's lines carefully bonded	Extensions made on petitions
Detroit, Mich	System affected to some extent	A bonus of 5 per cent for three years on the estimated cost of extension is required less the water rates in sight when line is laid
Flint, Mich	No noticeable damage	Extensions made when revenue equals 6 per cent of cost of line
Holland, Mich	No noticeable damage	Extensions made when revenue equals 10 per cent of cost of line
Ishpeming, Mich	Water mains are stave pipe. No electrolytic action	Extensions made on order of city council
Austin, Minn	No appreciable damage	Extensions made on guarantee of 6 per cent of cost of line
Duluth, Minn	Effect not particularly noticeable on mains, more so on services	Extensions are made on guarantee of 8 per cent annually on cost of main

Minneapolis, Minn.	Not affected to any appreciable extent. Extensive bonding of rails with return cables	Extensions made on payment of actual cost of line with maximum of 70 cents per front foot
St. Paul, Minn.	Considerable damage in some districts. Traction company pays for renewals when necessary	Water mains laid on assessment of 10 cents per lineal foot of frontage of each lot in front of which main is laid. This assessment running for ten years
Jackson, Miss.	Very little damage from electrolysis	Extensions made when number of consumers justify investment
Meridian, Miss.	Very little damage from electrolysis	Extensions made on a five year guarantee of 25 per cent of the cost of the main
Kansas City, Mo.	Damage not very serious. Water department is taking action against Traction company	When number of consumers justify the expenditure
Independence, Mo.	No appreciable damage. Rails well bonded	Extensions made on basis of one consumer to each 100 feet
St. Louis, Mo.	Effect noticeable on small mains and services only. Department expects to force payment for damages	On petition of property owners
Sedalia, Mo.	Damage localized (small)	Extensions made on orders from city council with 10 hydrants to mile or on basis of $50.00 for domestic consumption for each 600 feet
Springfield, Mo.	Had some trouble from electrolysis but since Traction company made improvements in their return cables the trouble has apparently been eliminated	Extensions are made on basis of hydrant to each 600 feet or 75 feet to each consumer
Dover, N. H.	Mains not seriously affected but some of the wrought iron services show electrolytic action. Railway company keeps rails well bonded	Extensions made on basis of guarantee of 5 per cent
Newark, N. J.	Mains are affected in certain districts. The Traction company has reimbursed the department for a part of the loss sustained	Extensions made on basis of 10 per cent of cost of line
Paterson, N. J.	System damaged but not serious. Traction company in few cases has paid for service pipes where there could be no question as to cause of injury	Extensions are made on basis of guaranteed revenue of 10 cents per foot per annum
Albuquerque, N. M.	Injury is quite severe at certain points. Traction company doing nothing to remedy trouble	Additions made on orders from city council on basis of 10 hydrants to a mile and domestic revenue equal to 6 per cent of cost of line
Binghamton, N. Y.	No noticeable damage	Frontage tax for all mains, bringing to the department about $10,500.00 annually
Buffalo, N. Y.	Having very little trouble with electrolysis. Traction company reimburses city for any loss on account of electrolysis	Extensions made on orders from common council

CITY	INFORMATION RELATIVE TO ELECTROLYTIC ACTION ON PIPES AND SERVICE LINES	PROVISIONS RELATIVE TO ADDITIONS TO DISTRIBUTION SYSTEM
Geneva, N. Y.	Very little appreciable damage	City is figuring on frontage tax but has not definitely decided on amount
Kingston, N. Y.	Very little damage from electrolysis. Traction company co-operated with city in an effort to eliminate this damage	Extensions made on basis of 6 per cent guarantee
Little Falls, N. Y.	No appreciable damage	Extensions made on guarantee of revenue equal to 10 per cent on investment. Annual frontage charge of 2 cents a foot on all streets where mains are laid
North Tonawanda, N. Y.	Wood mains not affected. Some trouble with services. Traction company paid for some services	Additions made on orders from board of public works
Troy, N. Y.	No noticeable effect from electrolysis	Extensions made on orders from common council. Have yearly frontage tax of 20 cents on improved property and 2 cents per foot on vacant property. This covers water for family use, etc.
Utica, N. Y.	Very little trouble now. Following trouble several years ago, the Traction company insulated the affected mains since which time there has been no noticeable damage	Extension made on order of council with one hydrant to each 525 feet or on petition of property owners on guarantee of 10 cents per foot or 10 per cent on actual cost for 5 years
Grand Forks, N. D.	No noticeable effect. Is preparing to make tests	Extensions are made by water department and cost of line up to 6 inches assessed against property, assessment being divided into 10 equal payments. Trunk mains in excess of 6 inches paid for by department
Cincinnati, Ohio	Mains not affected as double trolley is used. (Overhead metallic return.) Interurban company has made good damage discovered in newly annexed villages	Extensions made on guarantee of 10 per cent per annum on cost of 6 inch main. Where mains are laid in newly improved streets the cost is assessed against abutting property. Force mains in excess of 6 inches paid for by city. Extensions made on assurance of 6 per cent interest on investment for 10 years
Columbus, Ohio	Not much damage	Extensions made on assurance of 6 per cent interest on investment for 10 years
Delaware, Ohio	No trouble from electrolysis. Traction lines well bonded	Extensions made on order of city council with one hydrant for each 440 feet
Elyria, Ohio	System affected. Extent unknown	Extensions made on guarantee of 10 per cent of cost of line
Fremont, Ohio	Service lines affected. Traction company contesting ordinance requiring them to return stray currents	Extensions made on requirement of one consumer to each 100 feet of mains

Massillon, Ohio	Wrought iron services affected. Traction system not well bonded. Bills rendered to Traction company for damages	Extensions made on guarantee of 1 consumer for each 528 feet
Piqua, Ohio	Not bothered with electrolysis	Extensions made where income exceeds 60 per cent of cost of investment
Springfield, Ohio	System seriously affected in certain districts. Traction company attempting to remedy trouble	Extensions made when revenue equals 6 per cent of cost
Zanesville, Ohio	System apparently not affected	Extensions made when revenue equals 10 per cent of cost
Guthrie, Okla	No apparent damage	All extensions made by bond issue
Allentown, Pa	System slightly affected	Extensions made by ordinance of city council. Frontage charge 4 inch main, 30 cents; 6 inch main, 50 cents; 8 inch main, 70 cents; 12 inch main, $1.05; 16 inch main, $1.50; on each side of street
Altoona, Pa	In some locations the electrolytic action has destroyed about 2 blocks of mains. Traction company attempting to remedy trouble. City negotiating with Traction company relative to damage	Additions made from revenues of water department. Frontage charge of 25 cents per foot. Average revenue for past 5 years $15,000.00
Erie, Pa	Mains are affected. Traction company showing a disposition to eliminate trouble due to electrolysis and reimbursing water department for damage	Extensions made on bond insuring annual return equal to 7 per cent of cost
Johnstown, Pa	Some damage due to electrolysis. Careful examination made and interesting experiments tried in effort to eliminate the trouble. In some instances sections of cast iron pipe were replaced with wooden stave pipe and in other cases a special bell with wooden wedges instead of lead. Both types of insulators apparently effective	Extensions made when revenue equals 10 per cent of cost
Philadelphia, Pa	No injury whatever from electrolysis. Ex-Chief David R. Walker, Electrical Bureau, Philadelphia, compelled the Traction company to bond their rails from the time the first trolley line was built and it is owing o his foresight that we are entirely free from electrolysis	Extensions are made on authority of councils. Frontage tax of $1.00 for both sides of street or $2.00 per lineal foot of pipe laid. Receipts from this source have averaged $131,624.95 for the past five years
Reading, Pa	System affected very slightly	Extensions made on petition of property owners. Frontage tax of 50 cents per foot except on corner lots where allowance is made of one-third of length of lot. Average receipts for past five years $2,443.00

CITY	INFORMATION RELATIVE TO ELECTROLYTIC ACTION ON PIPES AND SERVICE LINES	PROVISIONS RELATIVE TO ADDITIONS TO DISTRIBUTION SYSTEM
Tacoma, Wash.	System not affected to any great extent. Traction company's lines well bonded	Extensions made on local improvement district plan. The abutting property in residence district pays cost of new main figured on basis of 6 inch line. Cost above this cost being paid by water department. In manufacturing or congested districts, the entire cost irrespective of size of main, is assessed against property benefited
Walla Walla, Wash.	System affected slightly. Traction company by franchise agrees to reimburse for all damages due to electrolysis which they have done	Extensions in old part of city made at the expense of water department. In the new additions a frontage charge is made. The money so received is merely used as a credit on the water rent
Ashland, Wis.	Service lines affected in certain districts near Traction power house. Traction company doing nothing to remedy this trouble	Extensions made on order of city. City paying for hydrants and hydrant rental at the rate of 10 hydrants per mile of main
La Crosse, Wis.	Slight damage noticeable on one or two services near the power house. Traction company has made good all damage. For the last three years, all new track has been equipped with a large return wire placed between the rails connecting all specials, and about every third or fourth rail. This is in addition to the regular welded or bonded joints	Extensions are made upon petition and order of the city council
Madison, Wis.	Have had some trouble with electrolysis, Traction company doing nothing to remedy trouble	Extension made upon petition, paving of street and connecting ends to insure circulation. Property pays entire assessment in front for 4 inch and 6 inch mains. Excess over 6 inches is paid by city
Wilkinsburg Sta., Pittsburgh, Pa.	Damage principally confined to lead service lines. Have found that the use of leadite materially decreases the amount of current through mains	Extensions made when revenue is equal to 15 per cent of cost of line. If cost does not equal that, petitioner pays cost of line and is rebated
Providence, R. I.	Serious damage to mains and service lines. Traction company coöperating with city in attempt to remedy trouble. Wooden insulating joints in mains and service pipes found to be effective	Extensions made when revenue equals 7 per cent of estimated cost
Memphis, Tenn.	Had ten or more cases during past year. Rendered bills against Traction company but charge has been disputed. If damage increases, city will probably bring suit	Extensions made on basis of one consumer to each 100 feet. In new sub-divisions owners pay cost of line and receive rebate

San Antonio, Texas.....	Damage not definitely known. Traction company bonding its rails	New city contract provides for 8 miles of pipes per year but revenue of 12 cents per foot must be guaranteed before mains are ordered
Ogden, Utah.....	Only very slight evidence of damage has been found. Traction company uses every care in matter of bonding	Extensions made on petitions
North Yakima, Wash.....	Not very much trouble as most of system is wood stave pipe	Extensions made whenever business will warrant. Usually figured on basis of 33⅓ per cent return on gross cost of line
Seattle, Wash.....	Damage serious in different localities. Some pipe had to be replaced on account of electrolysis. Traction company will admit no liability	Extensions made on petition of property owners or on order of city council, entire cost of 8 inch cast iron pipe assessed against property owners. Excess above 8 inches paid for out of water fund
Spokane, Wash.....	Damage by electrolysis very slight	Extensions made upon petition of 51 per cent of property affected. Cost paid by assessment against property
Roanoke, Va.....	Practically no damage	Extensions made when cost of main is deposited with water company. Said deposit is held until income on line equals 10 per cent of cost
Milwaukee, Wis.....	Slight damage by electrolysis. Traction company trying to correct conditions where evidence shows leakage	Extensions made on petition. Abutting property is assessed on the basis of the cost of laying a 6 inch main. Excess of 6 inches is paid out of water fund. Assessment for past five years has been 50 cents per lineal foot on each side of street
Cheyenne, Wyo.....	No damage from electrolysis	Extensions made upon petition of a majority of property owners along the line of proposed extension

Information relative to metered service

CITY	NUMBER METERS IN SERVICE	PERCENTAGE OF TAPS METERED	OWNED AND MAINTAINED BY WATER CO. OR DEPT.	OWNED BY CITY OR COMPANY; MAINTAINED BY CONSUMER	OWNED BY CONSUMER, MAINTAINED BY CITY OR COMPANY	OWNED AND MAINTAINED BY CONSUMER	HOW OFTEN ARE METERS READ?	DO YOU REQUIRE CASH DEPOSIT?	IF SO, WHAT AMOUNT?	DO YOU PAY INTEREST ON DEPOSIT?	IF SO, WHAT RATE?	IS METERING OPTIONAL WITH CITY AND CONSUMER?
Anniston, Ala.	130	15.0	+				Quarterly and monthly	Yes	$2.00	No		No
Bessemer, Ala.	1,500	53.0	+				Quarterly	No				With company
Mobile, Ala.	2,223	20.5	+				Monthly	No				Company
Phoenix, Ariz.	300	7.5	+				Monthly	No				Both
Fort Smith, Ark.	1,000	25.0	+			+	Monthly	Yes	3.00	No		Both
Pine Bluffs, Ark.	2,077	100.0	+				Monthly	Yes	2.00	Yes	6 per cent	Company
Pomona, Cal.	1,900	66.0			+		Monthly	No				
Sacramento, Cal.	None											
San Diego, Cal.	12,681	100.0	+				Monthly	No				Company
San Francisco, Cal.	17,923	30.0	+				Monthly	Yes				Partly with company
Stockton, Cal.	570	23.0	+				15 days	No				Both
Colorado Spr., Col.	213	18.8			+		Monthly	No				Both
Denver, Col.	330	0.75				+	Monthly	Yes				Company
Bristol, Conn.	1,251	75.0	+				Quarterly	No				Company
Hartford, Conn.	13,105	98.7	+				Monthly	No				
Manchester, Conn.		5.0	+				Monthly	No				Company
Meridian, Conn.	618	8.5			+		6 months	No				Both
New Britain.	4,651	98.0					Monthly	No				Compulsory
New Haven, Conn.	2,500	10.0	+				Monthly	No				Consumer
New London, Conn.	825	19.0	+				2 months	No				Both
Stamford, Conn.	2,200	58.0	+				8 times a year	Yes	10.00	None	None	Company

Wilmington, Del	7,574	39.1	+				Monthly	No				Both
Washington, D. C	31,103	45.0	+		+		9 times a year	No				
Jacksonville, Fla	7,368	79.48	+				Monthly	Yes				Compulsory
Tampa, Fla	1,383	21.0	+		+		Monthly	Yes				Both
Athens, Ga	1,440	100.0				+	Monthly	None				
Atlanta, Ga	24,670	97.0	+				Monthly	None				Compulsory
Macon, Ga	2,841	50.0	+				Monthly	None				Compulsory
Aurora, Ill	5,756	100.0				+	6 months	None				Compulsory
Cairo, Ill	218	7.0	+			+	Monthly	None				Both
Champaign, Ill	3,700	90.0				+	Quarterly and monthly	Yes		No		Compulsory
Decatur, Ill	5,492	100.0				+	Quarterly	No		No		Compulsory
Dixon, Ill	300	20.0				+	6 months	Sometimes				Yes
Elgin, Ill			+							No		City
Freeport, Ill	2,600	75.0	+				Monthly	None				Compulsory
Kankakee, Ill	277	8.0	+			+	Quarterly and monthly	No		No		Yes
Lincoln, Ill	541	43.0	+			+	Monthly	No		No		Yes
Oak Park, Ill	5,043	100.0				+	Monthly	No				Compulsory
Peoria, Ill	365	3.5	+			+	Monthly	No				Company
Quincy, Ill	3,500	62.0	+				Monthly	Yes		No		Both
Rockford, Ill	8,116	10.0	+				Quarterly	No				Compulsory
Springfield, Ill	4,925	81.4	+				Quarterly and monthly	No				Compulsory
Streator, Ill	350	10.0	+				Monthly	No		No		Both
Anderson, Ind	383	14.5	+				Monthly	Yes		No		Both
Brazil, Ind	120	96.0	+			+	Monthly	Partly		No		Compulsory
Elkhart, Ind	3,070	79.0	+				Quarterly, monthly and annually	No		No		
Evansville, Ind	43		+				Monthly	No				Company

+ Yes.

Information relative to metered service—Continued

CITY	NUMBER METERS IN SERVICE	PERCENTAGE OF TAPS METERED	OWNED AND MAINTAINED BY CITY OR COMPANY	OWNED BY CITY OR COMPANY; MAINTAINED BY CONSUMER	OWNED BY CONSUMER; MAINTAINED BY CITY OR COMPANY	OWNED AND MAINTAINED BY CONSUMER	HOW OFTEN ARE METERS READ?	DO YOU REQUIRE CASH DEPOSIT?	IF SO, WHAT AMOUNT?	DO YOU PAY INTEREST ON DEPOSIT?	IF SO, WHAT RATE?	IS METERING OPTIONAL WITH CITY AND CONSUMER?
Fort Wayne, Ind.	1,250	11.0	+				Quarterly and monthly	No				
Gary, Ind.	2,700	100.0	+				Monthly	Yes		Yes	6 per cent	Company
Hammond, Ind.	700	12.0	+				6 months	Yes	3.00	No		Both
Jeffersonville, Ind.	102	9.0	+				Quarterly and monthly	No		No		
Kokomo, Ind.	271	7.6					Monthly	No				Both
Logansport, Ind.	2						6 months					
Marion, Ind.	784	26.5	+				Quarterly	No				Both
Mishawaka, Ind.	200	10.0	+				Quarterly	Yes		No		Company
New Castle, Ind.	155		+			+	Quarterly	Yes		No		Both
Richmond, Ind.	3,041	63.0	+				Monthly and 6 months	Yes	5.00	No		Both
South Bend, Ind.	2,500	22.0	+					Yes	3.00	No		Both
Terre Haute, Ind.	2,093	35.0	+				Monthly	Yes	3.00-10.00	Yes	6 per cent	Both
Vincennes, Ind.	235	10.0	+				Monthly	No		No		Company
Burlington, Iowa.	200	9.0	+				Monthly	No				Company
Clinton, Iowa.	2,122	53.1	+			+	Monthly	No		No		Both
Council Bluffs, Ia.	2,800	50.0	+			+	Monthly	No				Company
Davenport, Iowa.	5,800	66.0	+				Monthly	Yes	5.00	No		Partly with consumer
Des Moines, Iowa.	14,553	96.8	+				Monthly	No		No		Both
Dubuque, Iowa.	3,900	98.0				+	Quarterly and monthly	Yes				Compulsory

Iowa City, Iowa	117	8.33	+				Monthly	No				Company
Keokuk, Iowa	1,575	64.9	+				Quarterly and monthly	No				Both
Muscatine, Iowa	250	9.66	+				Monthly	No		No		Both
Ottumwa, Iowa	850	50.0	+				Monthly	No		No		Both
Sioux City, Iowa	6,221	100.0	+				Quarterly and monthly	No				Compulsory
Waterloo, Iowa	3,843	94.0	+				Monthly	No		No		Compulsory
Atkinson, Kans	340	14.0	+		+		Monthly	Yes	2.50–5.00	No		Both
Fort Scott, Kans	1,200	60.0				+	Monthly	No				Both
Hutchinson, Kans	3,000	75.0	+				Monthly	Yes	1.00	No		Company
Lawrence, Kans	1,600	75.0	+				Monthly	No				Both
Parsons, Kans	1,800	75.0				+	Monthly	Yes	2.00	No		Both
Pittsburg, Kans	962	25.0	+			+	Monthly	Yes	3.00	No		Both
Wichita, Kans	3,183	48.0	+				Monthly	Yes	3.00	No		Both
Henderson, Ky	80	4.0	+				Monthly	No				Both
Lexington, Ky	5,130	100.0	+				Monthly	No		No		Compulsory
Louisville, Ky	3,022	7.9	+				Monthly	Yes	10.00	No		Water company
Alexandria, La	1,200	100.0			+		Quarterly and monthly	No		No		Compulsory
Baton Rouge, La	1,350	58.0	+				Quarterly and monthly	Yes	2.50			
									100.00	No		Company
Lake Charles, La	7	1.0	+				Monthly	Sometimes		No		
New Orleans, La	33,873	100.0	+				Quarterly	No		No		Compulsory
Baltimore, Md	3,000		+				Quarterly	At times			6 per cent	Compulsory
Hagerstown, Md	625	15.0	+				Monthly	None				Not optional
Arlington, Mass	2,366	100.0	+				Monthly	No			No	No
Beverly, Mass	726	16.5	+				Monthly	No				Company
Brockton, Mass	8,710	99.6	+				Monthly	No		No		Compulsory
Cambridge City, Mass	5,045	31.0	+				Monthly	No		No		Both

Information relative to metered service—Continued

CITY	NUMBER METERS IN SERVICE	PERCENTAGE OF TAPS METERED	OWNED AND MAINTAINED BY CITY OR COMPANY	OWNED BY CITY OR COMPANY; MAINTAINED BY CONSUMER	OWNED BY CONSUMER; MAINTAINED BY CITY OR COMPANY	OWNED AND MAINTAINED BY CONSUMER	HOW OFTEN ARE METERS READ?	DO YOU REQUIRE CASH DEPOSIT?	IF SO, WHAT AMOUNT?	DO YOU PAY INTEREST ON DEPOSIT?	IF SO, WHAT RATE?	IS METERING OPTIONAL WITH CITY AND CONSUMER?
Chelsea, Mass	4,617	98.0	+				Quarterly	No				Compulsory
Clinton, Mass	1,680	90.0	+				Monthly	No		No		Compulsory
Concord, Mass	32	2.5	+				Monthly	No				Optional with town
Everett, Mass	1,900	33.33	+				Quarterly	No		No		Compulsory
Fall River, Mass	8,988	99.0	+					No		No		Optional with both
Framingham, Mass	2,063	100.0	+				Monthly, quarterly and yearly	No				Compulsory
Gardner, Mass	129	6.9	+				Monthly	No		No		
Gloucester, Mass	399	8.3	+				Monthly	No				Optional with city
Haverhill, Mass	1,543	21.87	+				Semi-quarterly-monthly	No		No		Both
Lynn, Mass	7,141	45.0				+	Monthly	No		No		Both
Malden, Mass	7,400	97.0	+				Monthly	No		No		Compulsory
New Bedford, Mass	9,998	73.3	+				Monthly	No		No		Compulsory
Newburyport, Mass	110	3.0	+				Monthly	No		None		With city only
Northampton, Mass	131		+				Monthly	No		No		With city only
Summerville, Mass	7,164	56.0	+				Quarterly	No				Compulsory
Springfield, Mass	13,407	100.0				+	Quarterly	No				Meter required

Taunton, Mass	2,938	54.0	+		+			Yes	10.00	No		Optional
Waltham, Mass	633		+				Twice per quarter	No		No		
Winthrop, Mass	2,655	100.0	+				Quarterly	No		No		Compulsory
Adrian, Mich	500	25.0	+			+	Monthly					
Alpana, Mich	64	2.5	+			+	3 months	No		No		Optional with city
Ann Arbor, Mich	350		+				Monthly	No		No		Company
Battle Creek, Mich	5,769	97.0					Monthly and every 2 weeks	Yes	5.00	No		Compulsory
Bay City, Mich	2,212	40.0	+				Quarterly and monthly	No		No		Both
Detroit, Mich	10,807	11.0	+				Quarterly	No				Some cases compulsory
Escanaba, Mich	400	20.0	+				Quarterly and monthly	Yes				Optional with both
Flint City, Mich	2,149	40.0	+				Monthly	Yes		No		City
Holland, Mich	2,193	100.0	+				Quarterly	No		No		Compulsory
Ishpeming, Mich	1,577	78.0	+				Quarterly	No				Compulsory
Jackson, Mich	6,175	100.0	+				Quarterly	No				Compulsory
Ludington, Mich	1,600	85.0	+				Quarterly and monthly	No		No		Compulsory
Marquette, Mich	1,010	50.0	+				Quarterly	No				Both
Owosso, Mich	1,627	100.0	+				Quarterly	No				
Saginaw, Mich	340	4.35	+				Quarterly	No		No		Both
Traverse City, Mich	781	37.0	+				Quarterly	No				City
Duluth, Minn	6,552	60.0	+				Monthly	Yes		Yes	5 per cent	Some cases
Minneapolis, Minn	42,000	90.0			+		Quarterly	No				Optional with city
St. Paul, Minn	19,584	591.0	+				Monthly					Compulsory
Stillwater, Minn	None							No		No		

Information relative to metered service—Continued

CITY	NUMBER METERS IN SERVICE	PERCENTAGE OF TAPS METERED	OWNED AND MAINTAINED BY CITY OR COMPANY	OWNED BY CITY OR COMPANY; MAINTAINED BY CONSUMER	OWNED BY CONSUMER; MAINTAINED BY CITY OR COMPANY	OWNED AND MAINTAINED BY CONSUMER	HOW OFTEN ARE METERS READ?	DO YOU REQUIRE CASH DEPOSIT?	IF SO, WHAT AMOUNT?	DO YOU PAY INTEREST ON DEPOSIT?	IF SO, WHAT RATE?	IS METERING OPTIONAL WITH CITY AND CONSUMER?
Virginia, Minn	200	12.0	+				Quarterly	No		No		Both
Jackson, Miss	1,600	35.0	+				Monthly	No		No		Compulsory
Meridian, Miss	2,200	60.0	+				Monthly	Yes	2.00	Yes	4 per cent	City
Independence, Mo	1,396	75.0	+				Quarterly and monthly	No		No		City
Kansas City, Mo	25,269	50.0				+	Monthly	Yes		No		
Moberly, Mo	1,170	90.0	+				Monthly	Yes	1.00	No		
St. Joseph, Mo	2,187	17.5	+			+	Monthly	Yes		No		Both
St. Louis, Mo	7,366	6.0	+			+	2 months	Yes		No		Below ¼ optional
Sedalia, Mo	705	35.0	+				Monthly	No				
Springfield, Mo	1,300	20.0	+			+	Quarterly and monthly	No		Yes	8 per cent	Both
Billings, Mont	360	16.0	+				Monthly	Sometimes				Company
Butte, Mont	573		+				Monthly	Yes				Company
Missoula, Mont	150		+				Monthly	No		No		Both
Omaha, Neb	20,593	85.0				+	Monthly	Sometimes		No		Compulsory
Concord, N. H	2,243	59.0	+				Quarterly	No				City
Dover, N. H	1,438	74.0				+	Quarterly	No				Compulsory except one family
Keene, N. H	190		+			+	Quarterly	No		No		Both
Manchester, N. H	5,689	77.0	+				Monthly	No				Both
Bridgeton, N. J	No meters used											

Camden, N. J.	1,131	0.05	+				Monthly	No				Both
Garfield, N. J.	1,300	90.0	+				Quarterly	No				Compulsory
Newark, N. J.	24,729	54.0				+	Quarterly	No		No		Compulsory
Passaic, N. J.	3,782	53.0	+				Quarterly and monthly	Sometimes		5.00	5 per cent	Not altogether
Paterson, N. J.	8,438	55.0	+				Quarterly and monthly	Sometimes		5.00	5 per cent	
Perth Amboy, N. J.	1,366	29.0	+									
Phillipsburg, N. J.	66		+				Quarterly	No		No		
Rahway, N. J.	180	10.0						No		No		
West Orange, N. J.	1,671	97.0	+				Quarterly	Yes	5.00	Yes	4 per cent	
Albuquerque, N. M.	2,478	96.0	+				Monthly	No		No		Both
Las Vegas, N. M.	12	0.75	+				Monthly	No				Both
Auburn, N. Y.	702	7.3	+				Monthly	No				Neither
Binghamton, N. Y.	4,000	45.0	+				Semi-Annually, monthly and bi-monthly	No				Compulsory
Cortland, N. Y.	1,640	68.0	+				Quarterly	No				
Dunkirk, N. Y.	3,188	99.0			+		3 times year	No		No		Compulsory
Elmira, N. Y.	3,559	46.0	+				Quarterly	Yes	5.00	Yes	6 per cent	Over $14 flat rate compulsory
Geneva, N. Y.	2,950	100.0	+				Quarterly	No				Compulsory
Glens Falls, N. Y.	39	1.1	+				Monthly	No				Company
Gloversville, N. Y.	3,630	93.0	+				Every 2 months					Compulsory
Jamestown, N. Y.	6,000	80.0	+				Quarterly	No				Optional with city
Kingston, N. Y.	125	2.5	+					No		No		
Little Falls, N. Y.	331	16.0	+				Monthly	Yes	Yearly flat rate			City

Information relative to metered service—Continued

CITY	NUMBER METERS IN SERVICE	PERCENTAGE OF TAPS METERED	OWNED AND MAINTAINED BY CITY OR COMPANY	OWNED BY CITY OR COMPANY; MAINTAINED BY CONSUMER	OWNED BY CONSUMER; MAINTAINED BY CITY OR COMPANY	OWNED AND MAINTAINED BY CONSUMER	HOW OFTEN ARE METERS READ?	DO YOU REQUIRE CASH DEPOSIT?	IF SO, WHAT AMOUNT?	DO YOU PAY INTEREST ON DEPOSIT?	IF SO, WHAT RATE?	IS METERING OPTIONAL WITH CITY AND CONSUMER?
Mt. Vernon, N. Y.	5,000	100.0	+				Quarterly	No		No		Compulsory
New Rochelle, N. Y.	6,164	99.0	+				Semi-annually, quarterly	No				Compulsory
North Tonawanda, N. Y.	50		+				3 months	No		No		
Ogdensburg, N. Y.	10	0.0003	+				Quarterly	No		No		Both
Olean, N. Y.	2,877	100.0			+		Quarterly	No		No		Compulsory
Ossining, N. Y.	1,385				+		Annually, semi-annually and quarterly	No				Compulsory
Rensselaer, N. Y.	140	8.0	+				Quarterly and monthly	No				Both
Schenectady, N. Y.	240	2.0	+				Quarterly	No				Compulsory
Syracuse, N. Y.	25,114	97.0				+						
Troy, N. Y.	400	3.5	+					No				Both
Utica, N. Y.	12,411	96.0	+				Quarterly and monthly	Some		6 per cent		Company
Waterford, N. Y.	740	89.0				+	Quarterly and monthly	Some				Compulsory
Watertown, N. Y.	690		+				Monthly, semi-annually	No		No		

Whiteplains, N. Y.	3,213	99.0	+				Quarterly	None				City
Yonkers, N. Y.	8,886	100.0	+		+		Weekly, monthly and quarterly	No				Compulsory
Asheville, N. C	2,500		+				Monthly	No				Compulsory
Durham, N. C.	1,350		+				Weekly, monthly and quarterly					Compulsory
Wilmington, N. C.	1,390	45.0	+				Monthly	No		No		Both
Grand Forks, N. D.	1,785	80.0			+		Monthly	No				Compulsory
Canton, O.	926	10.0	+				Quarterly	No		No		City
Cincinnati, O	25,489	47.6			+		Monthly	No				
Columbus, O.	26,769	93.43			+		Semi-annually, bi-monthly and monthly	Yes		Depend	on service	Compulsory
Elyria, O.	3,571	100.0	+				Quarterly and monthly	Advance payment				Compulsory
Fremont, O	1,730	93.0	+				Quarterly	No				Compulsory
Marion, O.	2,100	90.0	+		+		Quarterly and monthly	No				Compulsory
Massillon, O.	1,000	33.33	+				Quarterly	No				Some cases
Middletown, O.	1,450	55.0	+			+	Quarterly	No				Compulsory
Newark, O.	2,300	66.66				+	Quarterly	No		None		Compulsory
Piqua, O.	None. Cannot use them account of supply of water furnished											
Springfield, O.	2,000	20.0				+	Monthly	No				Both
Tiffin, O.			+									
Warren, O.	2,063	67.0	+				Monthly	Yes	5.00	No		Compulsory
Youngstown, O.	4,161	28.0				+	Quarterly	No				Compulsory
Zanesville, O.	50	Less than 1.0	+				Monthly	No		No		Company

Information relative to metered service—Continued

CITY	NUMBER METERS IN SERVICE	PERCENTAGE OF TAPS METERED	OWNED AND MAINTAINED BY CITY OR COMPANY	OWNED BY CITY OR COMPANY; MAINTAINED BY CONSUMER	OWNED BY CONSUMER; MAINTAINED BY CITY OR COMPANY	OWNED AND MAINTAINED BY CONSUMER	HOW OFTEN ARE METERS READ?	DO YOU REQUIRE CASH DEPOSIT?	IF SO, WHAT AMOUNT?	DO YOU PAY INTEREST ON DEPOSIT?	IF SO, WHAT RATE?	IS METERING OPTIONAL WITH CITY AND CONSUMER?
Guthrie, Okla	850	65.0	+				Monthly	No				Company
Muskogee, Okla	3,000	64.0	+				Quarterly and monthly	Yes	3.00			
Oklahoma, Okla	7,350	75.0	+				Monthly	Yes by tenant		2 months over bill	No	Compulsory
Shawnee, Okla	1,400	73.7	+				Monthly	Yes	5.00	No		Compulsory
Portland, Ore	13,221	22.1	+				Monthly	Advance payment				City
Allentown, Pa	89	0.0067	+				Monthly	No		No		Consumer
Altoona, Pa	616	4.7				+	Monthly	No				Both
Bradford, Pa	116						Quarterly	No				Company
Duquesne, Pa	1,675	100.0	+				Monthly	No		No		Compulsory
Erie, Pa	406	3.0	+				Monthly	No		No		Company
Johnstown, Pa	1,511	14.6	+				Quarterly	No		None		Company
Lebanon, Pa	117		+				Monthly	No				Company
McKeesport, Pa	3,606	50.0				+	Quarterly	No		No		Consumer
Meadville, Pa	1,764	66.5				+	Quarterly	No				Both
Philadelphia, Pa	4,850	1.4	+			+	Quarterly	No		None		Both
Reading, Pa	4,177	18.3	+				Monthly	No				Both
Sharon, Pa	1,354		+			+	Monthly					Both
Shenandoah, Pa	25		+				Semi-monthly	No		None		
Sunbury, Pa	50	0.00156	+				Bimonthly	None		None		Company
Williamsport, Pa	115	2.0	+				Monthly	None				Company

Pawtucket, R. I.											
Providence, R. I.	26,298	90.0			+		Quarterly few months	Minimum charge in advance			Both
Charleston, S. C.	250		+				Monthly	No		No	Both
Columbia, S. C.	3,120	100.0	+				Quarterly	No			Compulsory
Jackson, Tenn.	40	1.0	+				Monthly	No			Department
Memphis, Tenn.	12,451	54.5	+				Monthly	Yes		2 months bill	Department
Nashville, Tenn.	13,320	80.0	+				Quarterly and monthly	No		No	Both
Denison, Texas	2,600	85.0	+				Monthly	Yes	1.50		Company
El Paso, Texas	4,673	75.0	+				Monthly	Yes	2.00–50.00	No	
Galveston, Texas	6,041	100.0	+		+		Monthly	No			Compulsory
Laredo, Texas	300	25.0	+				Monthly	No		No	Company
San Antonio, Texas	4,542	20.0	+		+		Monthly	Yes	3 mos. $10 flat rate except owner	6 per cent	Both
Temple, Texas	855	45.0			+		Quarterly	No			Both
Waco, Texas	650	8.0	+				Monthly	Yes from tenants	1 month flat rate		Company
Ogden, Utah	325		+				Monthly	Yes	20.00	No	Both
Salt Lake City, Utah	800	4.5	+				Quarterly and monthly	Yes	Cost of meter	No	Consumer
Burlington, Vt.	3,503	87.38	+				Quarterly and monthly	No			Both
Rutland, Vt.	150		+				Monthly	No			
Lynchburg, Va.	475	8.0	+		+		Monthly	No		No	Both
Richmond, Va.	18,739	70.0	+				Monthly	No			Compulsory
Roanoke, Va.	3,483	49.0	+		+			No			Compulsory
North Yakima, Wash.	3,226	98.0	+				Monthly	Yes	3.00–5.00	Yes	8 per cent

Information relative to metered service—Continued

CITY	NUMBER METERS IN SERVICE	PERCENTAGE OF TAPS METERED	OWNED AND MAINTAINED BY CITY OR COMPANY	OWNED BY CITY OR COMPANY; MAINTAINED BY CONSUMER	OWNED BY CONSUMER; MAINTAINED BY CITY OR COMPANY	OWNED AND MAINTAINED BY CONSUMER	HOW OFTEN ARE METERS READ?	DO YOU REQUIRE CASH DEPOSIT?	IF SO, WHAT AMOUNT?	DO YOU PAY INTEREST ON DEPOSIT?	IF SO, WHAT RATE?	IS METERING OPTIONAL WITH CITY AND CONSUMER?
Seattle, Wash	31,890	77.5	+				Monthly	Don't use				Compulsory
Spokane, Wash	7,690	31.0			+		Monthly and 3 times year	No				Optional with both
Tacoma, Wash	1,356	10.7	+				Monthly	No		No		
Walla Walla, Wash	182		+		+		Monthly	No				Both
Ashland, Wis	543	27.5	+		+		Monthly	Yes	3 months av. bill	No		Both
Beloit, Wis	1,765	82.0	+				Quarterly	Yes	3 months av. bill	Yes	3 per cent	Compulsory
Green Bay, Wis	4,687		+				Monthly and 3 months	Yes	3 months av. bill	No		Compulsory
La Crosse, Wis	2,470	48.1				+	Quarterly	Advance payment				1 inch under—optional over—compulsory
Madison, Wis	5,453	99.4	+				Monthly	No				Compulsory
Marinette, Wis	97	25.0	+				Monthly	No				Both
Milwaukee, Wis	57,657	98.8	+				Monthly	No				Compulsory
Racine, Wis	5,574	72.7	+					No				Both
Superior, Wis	4,408	86.0	+				Monthly	Yes	3.00	No		Compulsory

Cheyenne, Wyo.	1						Monthly	No				Over 1 inch
Hollister, Cal.	251	30.0	+				Monthly	No				
National City, Cal.	843	63.0	+				Monthly	Sometimes				Both
Reedley, Cal.	30	10.0	+				Monthly	No				Both
Daytona, Fla.	370	100.0	+				Quarterly	Yes	5.00			Compulsory
Miami, Fla.	1,505	100.0	+				Quarterly and monthly	Advance payment ($3 per quarter)				
Downey, Idaho	55	100.0	+		+		Monthly	No				Compulsory
Lake Forest, Ill.	695	100.0				+	Quarterly	No				
Valparaiso, Ind.	725	50.0				+	Monthly	No				Both
Washington, Ind.	250	26.0	+		+		Quarterly	No		No		Optional with consumer
Creston, Iowa	464	71.2				+	Quarterly	No				Company
Danville, Ky.	730	100.0	+				Monthly	No				Compulsory
Brunswick, Me.	350	30.0	+		+		Quarterly and monthly	Advance payment				Compulsory
Reading, Mass.	1,390	92.0	+				Monthly	No		No		Department
Coldwater, Mich.	None											
Mt. Clemens, Mich.	850	50.0	+				Quarterly and monthly	No				Compulsory
Austin, Minn.	902	90.0	+				Quarterly	Yes	Advance minimum 90 cents			
Yazoo City, Miss.	576	49.0	+				Monthly	No		None		Compulsory
Excelsior Spr., Mo.	647	100.0	+				Monthly	Yes	45 days			Compulsory
Canandaigua, N. Y.	1,677	100.0				+	Quarterly and monthly	No	Average bill	None		Compulsory
Huntington, L. I.	900	90.0	+				Quarterly	No				
Norwich, N. Y.	14	1.0	+				Quarterly	No		None		

Information relative to metered service—Continued

CITY	NUMBER METERS IN SERVICE	PERCENTAGE OF TAPS METERED	OWNED AND MAINTAINED BY CITY OR COMPANY	OWNED BY CITY OR COMPANY; MAINTAINED BY CONSUMER	OWNED BY CONSUMER; MAINTAINED BY CITY OR COMPANY	OWNED AND MAINTAINED BY CONSUMER	HOW OFTEN ARE METERS READ?	DO YOU REQUIRE CASH DEPOSIT?	IF SO, WHAT AMOUNT?	DO YOU PAY INTEREST ON DEPOSIT?	IF SO, WHAT RATE?	IS METERING OPTIONAL WITH CITY AND CONSUMER?
Seneca Falls, N. Y.	65	.....	+	.....	.....	.....	.....	Sometimes	.....	None	.....	Consumer
Elizabeth City, N. C.	49	10.0	+	.....	.....	.....	Monthly	Depends	.....	No	.....	Company
Conneaut, Ohio	1,000	45.0	+	.....	.....	.....	Quarterly and monthly	Property owner responsible	.....	.....	.....	Both
Delaware, Ohio	955	.....	+	.....	.....	.....	.....	No	.....	.....	.....	.....
Nazareth, Pa.	60	.....	+	.....	.....	.....	Monthly	.....	.....	.....	.....	Company
New Holland, Pa.	.....	10.0	.....	.....	.....	.....	.....	No	.....	.....	.....	Both
North East, Pa.	60	8.0	.....	.....	.....	+	Monthly	No	.....	.....	.....	Both
Mitchell, S. D.	528	98.0	+	.....	.....	.....	6 months	Yes	6.00	No	.....	.....
Clarksville, Tenn.	150	15.0	+	.....	.....	.....	Monthly	Yes	Advance payment	.....	.....	.....
Manchester, Vt.	237	65.0	+	.....	.....	.....	.....	.....	.....	.....	.....	.....
Anacortes, Wash.	240	40.0	+	.....	.....	.....	Monthly	Yes	.....	.....	After 6 months 8 per cent	.....
Hoquiam, Wash.	300	18.0	+	.....	.....	.....	Monthly	Yes	Previous consumption	.....	.....	Both
Waukesha, Wis.	1,628	100.0	+	.....	.....	.....	Quarterly and monthly	No	.....	.....	.....	Compulsory
Newport, Ky.	2,400	35.0	.....	.....	.....	+	Quarterly	Yes	2.50	No	.....	Compulsory

Some remarks of water works superintendents relative to the metering of fire lines

"We have never proven any loss but always suspect it."

"Any legitimate effort to diminish fires should be fostered, particularly by municipally owned plants where the stockholders and the patrons are practically the same parties. The expense of a fire line meter, whether owned by the water department or by the consumer, falls upon the consumer either as first cost or as charge for fire service. This expense will keep many who otherwise have fire lines from installing them. It is the writer's opinion that the better plan is to seal all outlets, to inspect seals at irregular times, and to impose a heavy penalty for seals found broken on inspection; it being a rigid rule that the patron must notify the department at once of any broken seals so that they may be promptly replaced. Repeated violation of the rule that the line shall be used exclusively for fire extinguishing should deprive the offender of the use of the fire line."

"Without meters on fire services it is impossible to get the amount of waste water to a minimum."

"To meter is the only sure way to prevent stealing, intentional or otherwise, of water."

"I feel that universal metering upon every supply and charges accordingly is the only fair and proper method for a city to adopt."

"I most emphatically do, for while I believe most men are honest, the temptation to steal water from an unmetered fire service is too strong to resist in some cases."

"An unmetered fire line is one of the most dangerous frauds ever perpetrated on a water plant."

"Installed one 10-inch and 12-inch H. F. Meters at large mill with two miles of yard piping, formerly supplied by 15 smaller meters. After installation, consumption recorded was three and one-half times greater than formerly recorded by old interior meters. This wastage was largely caused by yard leakage unknown to both company and consumer. After leaks were repaired, consumption has continued to be practically twice the original amount of old interior meters."

"We recommend the metering of all services, otherwise you run the chance of losing both by theft and leakage. A few years ago, one of our mills was glad to settle a case for $7500 and an illustration of the other point occurred last summer. We located the leak after considerable trouble and a meter sat at this point showed a waste of 10,000 cubic feet a day. The break occurred in the mill yard and drained into a nearby pond, there being no sign on the surface of the ground that indicated trouble."

"We recommend the metering of fire services as a prevention of waste, and prevents the inclination of consumers to tap fire lines for other purposes, thereby escaping just payment for the other purposes."

Information relative to

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
Alabama								
Anniston	Springs					No		No
Bessemer	Springs					No	No	No
Mobile	Mountain creeks					No	Yes	No
Arizona								
Phoenix	Wells	12–16	200	8,000,000		No	No	No
Arkansas								
Fort Smith	Surface water				Poteau River	Yes	No	No
Pine Bluff	Wells	10	800	1,600,000		No	No	No
California								
Pomona	Tunnels and wells	12	550			No	No	No
Sacramento	Surface				Sacramento River	No	No	No
San Diego	Surface				Sacramento River	Yes	No	No
San Francisco	Surface and wells	10	75–200			Partly	No	No
Stockton	Wells	12–16	800–1100			No	No	No
Colorado								
Colorado Springs	Surface				Slopes of Pikes Peak	No	No	No
Denver	Surface				Mountain stream	Yes	Yes	No
Connecticut								
Bristol	Surface					No	No	No
Hartford	Surface					Yes	Yes	No
Manchester	Surface and springs					No	No	No
Meriden	Surface				Shed area	No	Yes	No
New Britain	Surface				Brooks and shed area	No	No	No
New Haven	Surface				Lakes and rivers	Yes	No	No
New London	Surface				Lake Konomoe	No	No	No
Stamford	Surface				Reservoirs	No	Yes	No
Delaware								
Wilmington	Surface				Brandywine Creek	Yes	No	No
District of Columbia								
Washington	Surface				Potomac River	Yes	No	No
Florida								
Jacksonville	Wells	6–12	985–1015	11,936,462		No	No	No
Miami	Wells	6–8	85–90	3,500,000		No	No	No
Georgia								
Athens	Oconee River					Yes	Yes	No
Atlanta	Surface				Chattahoochee River	Yes	No	No

source of water supply, etc.

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
None	Pumpage	Reservoir	58,000,000	1,933,000	80,540	148	95	60–100
None	Pumpage	Reservoir	28,000,000	933,000	38,875	100	80–90	80–90
Yes	Pumpage	Reservoir	372,472,940	12,230,402	509,370	81	81	81
No	Pumpage	Stand pipe	72,000,000	2,400,000	100,000	85–45	80–40	80–40
None	Pumpage	Reservoir	70,833,333	2,361,111	98,380	85	85	85
Yes	Pumpage	Direct	.....	.....	.....	.....	100–45	100–45
.....	Both	Reservoir	70,000,000	2,750,000	98,000	.....	125–45	45
None	Pumpage	Direct	435,000,000	14,187,591	500,000	60–40	60–40	60–40
Yes	Gravity	Direct	174,500,000	5,750,000	240,000	123–90	100–60	140–25
.....	Both	Both	1,173,600,000	39,120,000	1,630,000	.....	90–40	.....
None	Pumpage	Stand pipe	120,000,000	4,000,000	300,000	60–50	40–45	40–45
.....	Gravity	Direct	195,774,000	6,436,400	268,183	.....	80–70	125–60
Yes	Both	Both	1,319,951,163	43,277,087	1,803,211	80	80–60	90–45
Yes	Gravity	.....	30,000,000	1,000,000	41,700	130	40	40
Yes	Gravity	.....	259,200,000	8,640,000	360,000	.....	80–60	75–30
None	Gravity	.....	.....	.....	.....	.....	70–64	100–40
Yes	Both	Reservoir	93,600,000	3,122,000	130,000	100	115–100	115–20
Yes	Gravity	Direct	15,000,000	500,000	21,000	80	80	80
Yes	Both	Reservoir	805,000,000	23,500,000	998,000	35–45	35–45	35–45
Yes	Gravity	.....	90,000,000	3,000,000	125,000	.....	60–70	40–60
Yes	Gravity	.....	90,000,000	3,000,000	125,000	.....	60–75	60–75
Yes	Pumpage	Reservoir	330,000,000	11,231,576	465,000	Low service, 20–59 High service, 20–93 Extra high service, 30–80		
Yes	Pumpage	Filter plant	1,887,000,000	62,000,000	2,500,000	35–140	40–60	20–100
Yes	Pumpage	Direct and stand pipe	135,484,919	5,378,756	224,114	60–110	50–110	50–110
None	Both	Stand pipe	316,306,500	10,543,550	476,315	513	45–75	40–75
Yes	Pumpage	Stand pipe	31,482,500	1,049,417	43,725	135	100	80
Yes	Pumpage	Direct	498,213,980	16,607,133	691,964	115–135	60	60

Information relative to source

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
Georgia—con.								
Macon	Surface				Ocmulgee River	Yes	No	Yes
Idaho								
Downey	Springs					No	No	No
Illinois								
Aurora	Wells	6–18	2,250	3,960,000		No	No	No
Champaign	Wells		158	1,920,000		Yes	No	No
Decatur	Surface				Sangamon River	Yes	Yes	No
Elgin	Wells	8–12	13,00–2,000			No	No	No
Dixon	Wells	8	1800	1,500,000		No	No	No
Freeport	Wells	2½–8				Yes	No	Yes
Kankakee	Surface				Kankakee River	Yes	Yes	No
Lake Forest	Surface				Lake Michigan	Yes	Yes	No
Lincoln	Wells		18			No	No	No
Oak Park	Surface				Lake Michigan	No	No	No
Peoria	Wells	7–34.5	50	13,000,000		No	No	No
Quincy	Surface				Mississippi River	Yes	Yes	No
Rockford	Wells	12–18	1,400–1,500			No	No	No
Springfield	Wells	12	40–50			No	No	No
Streator	Surface				River	Yes	Yes	No
Indiana								
Anderson	Surface				White River	Yes	Yes	No
Brazil	Wells	6–8	90–120			No	No	No
Elkhart	Wells	40	45	6,000,000		No	No	No
Evansville	Surface				Ohio River	Yes	Yes	No
Fort Wayne	Rock Wells	8	130–325					
Gary	Surface				Lake Michigan	No	No	No
Hammond	Surface				Lake Michigan	No	No	No
Indianapolis	Surface and wells	8–10	350		White River	Yes	Yes	No
Jeffersonville	Wells	12	40			No	No	No
Kokomo	Wells	6–8	130			No	No	No
Logansport	Surface				Eel River	No	No	No
Marion	Wells	8	120–307	2,500,000		No	No	No
Mishawaka	Wells	10	200–300	6,000,000		No		No
New Castle	Wells	4–6–8	90	1,500,000		No	No	No
Richmond	Surface				In filtration	No		No

of water supply, etc.—continued

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
Yes	Pumpage	Both	142,000,000	4,700,000	200,000	70–118	70	50
None	Gravity	.....	.....	.....	.....	100	.....	.....
Yes	Pumpage	Direct and stand pipe	70,356,750	2,313,099	96,379	75	76	55–76
None	Pumpage	Reservoirs	45,000,000	1,500,000	62,500	45–95	40–80	25–80
.....	Pumpage	Direct	110,000,000	3,650,000	153,000	85	65	50
.....	Pumpage	Direct	47,692,336	1,567,967	65,332	80	90	40–80
None	Pumpage	Direct and stand pipe	24,000,000	800,000	33,333	65	55	45
Check required	Pumpage	Stand pipe	55,333,185	1,814,203	75,592	82	70–80	35–80
None	Pumpage	Direct	69,900,000	2,330,000	97,083	70–110	60–100	50–90
None	Pumpage	Stand pipe	21,000,000	700,000	29,167	90–140	30–60	60–120
None	Pumpage	Direct and stand pipe	20,000,000	670,000	27,916	63–110	40–85	40–85
.....	Pumpage	Direct	47,220,000	1,570,000	65,416	50–75	.....	.....
Check required	Pumpage	Direct and reservoirs	255,335,000	8,400,000	350,000	130	85–110	30–85
Check required	Pumpage	Direct and reservoirs	60,794,900	1,998,738	83,281	90	45	5.75
Check required	Pumpage	Direct	95,571,513	3,221,511	134,229	60–85	.....	.....
None	Pumpage	Reservoirs and direct	159,000,000	5,300,000	220,833	85–100	25–30	25–30
None	Pumpage	Direct	60,000,000	2,000,000	82,500	65–120	45–90	45–70
Check required	Pumpage	Direct	41,787,604	1,373,839	57,243	65–115	45–95	45–95
None	Pumpage	Direct	15,700,000	500,500	20,854	70–80	50–60	20–65
None	Pumpage	Direct	64,362,058	2,145,402	89,392	60–90	50–80	50–80
None	Pumpage	Direct	234,660,000	9,358,700	390,000	50–100	45–100	35–90
Check required	Gravity	Reservoir	168,750,000	5,625,000	234,375	60	35–40	35–40
Check required	Pumpage	Direct and stand pipe	44,983,000	1,479,000	61,625	57–140	53–130	53–130
None	Pumpage	Direct	249,217,082	819,317	34,138	60	45	30
Check required	Pumpage	Direct	.....	.....	.....	60–120	55–110	50–100
None	Pumpage	Stand pipe	25,500,000	850,000	35,416	55–100	50–75	50–75
Not allowed	Pumpage	Direct	62,048,000	2,034,000	84,750	60–100	40–90	40–90
.....	Pumpage	Direct	135,000,000	4,500,000	187,500	50–100	40–90	40–90
2 checks required	Pumpage	Direct and reservoir	51,996,305	1,704,797	71,033	50–120	50–120	50–120
None	Pumpage	Direct	90,000,000	3,500,000	166,666	60–100	50–90	40–80
Check required	Pumpage	Direct	42,000,000	1,400,000	58,333	100–150	60–110	40–90
None	Both	Direct and reservoir	81,560,000	2,681,000	111,708	80	70	50–75

Information relative to source of

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
Indiana								
South Bend..	Wells	4–10	115	.....	.....	No	No	No
Terre Haute .	Surface	.....	.....	.....	Wabash River	Yes	Yes	No
Vincennes....	Surface	.....	.....	.....	Wabash River	Yes	Yes	No
Valparaiso ...	Lake and wells	10–12	110	1,100,000	.....	Yes	Yes	No
Iowa								
Burlington...	Surface	.....	.....	.....	Mississippi River	Yes	No	No
Clinton.....	Wells	.....	1,200–2,100	2,250,000	Mississippi River	Yes	Yes	No
Council Bluffs	Surface	.....	.....	.....	Mississippi River	Yes	Yes	No
Creston	Surface	.....	.....	.....	Improved reservoir	Yes	No	No
Davenport...	Surface	.....	.....	.....	Mississippi River	Yes	Yes	No
Des Moines..	Surface	.....	.....	.....	Collecting conduits	Yes	Yes	No
Iowa City....	Surface	.....	.....	.....	River	Yes	Yes	No
Keokuk.....	Surface	.....	.....	.....	Mississippi River	Yes	Yes	No
Muscatine....	Wells	6–8	50	.....	.....	No	No	No
Ottumwa.....	Surface	.....	.....	.....	Des Moines River	Yes	Yes	No
Sioux City ...	Wells	2–8–16	75–400	.....	.....	No	No	No
Waterloo	Wells	6–12	1,375	3,000,000	.....	No	No	No
Kansas								
Atchison.....	Surface	.....	.....	.....	Mississippi River	Yes	Yes	No
Fort Scott....	Surface	.....	.....	.....	Marmaton River	Yes	No	No
Hutchinson..	Wells	6	75	.....	.....	.....	.....	.....
Lawrence	Wells	6–50	30–45	.....	.....	No	No	No
Parsons	Surface	.....	.....	.....	Lavitte and Mosho Rivers	Yes	No	No
Pittsburg.....	Wells	8–16	.....	.....	.....	No	No	No
Wichita	Wells	8	30–40	.....	.....	No	No	No
Kentucky								
Danville	Surface	.....	.....	.....	Di River	Yes	No	No
Henderson ...	Surface	.....	.....	.....	Ohio River	No	No	No
Lexington....	Surface	.....	.....	.....	Improved reservoir	Yes	Yes	No
Louisville	Surface	.....	.....	.....	Ohio River	Yes	No	No
Newport	Surface	.....	.....	.....	Ohio River	Yes	Yes	No
Louisiana								
Alexandria ...	Wells	6–10–12	1100	1,650,000	.....	No	No	No
Baton Rouge.	Wells	6–8–10	856–1,310	.....	.....	No	No	No
Lake Charles.	Wells and surface	10	600–700	.....	Calcasieu River	No	No	No

water supply, etc.—Continued

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
.....	Pumpage	Stand pipe	150,000,000	5,000,000	208,333	97–75	97–75	80–70
Not allowed	Pumpage	Direct	133,000,000	4,400,000	183,333	70–130	40–110	40–110
None	Pumpage	Stand pipe	36,000,000	2,250,000	94,000	70	70	70
None	Pumpage	Direct	26,497,017	855,082	35,625	30–70	40–115	40–115
Valve required	Pumpage	Direct	63,487,255	2,193,798	91,408	100	90	30–50
Check required	Pumpage	Direct	60,100,000	2,000,000	83,333	50–100	50–100	50–100
None	Pumpage	Reservoir	92,000,000	3,125,000	130,208	110–140	90	0–105
No	Pumpage	Direct and stand pipe	18,171,838	605,720	25,000	80–130	40–90	40–90
Check required	Pumpage	Direct	120,000,000	4,000,000	166,667	80	65	40–100
None	Pumpage	Direct	164,176,197	5,386,104	224,421	100	95–100	30–100
None	Pumpage	Direct	54,093,095	1,778,404	74,100	65–135	45–115	25–135
Check required	Pumpage	Direct	37,200,000	1,300,000	54,166	70–125	50–120	50–120
None	Pumpage	Reservoir and direct	35,914,000	1,500,000	60,000	90	50–125	10–150
None	Pumpage	Reservoir	51,030,000	1,701,000	70,875	83	80–85	60
None	Both	Both	92,878,018	3,095,933	128,997	120	90–105	35–100
None	Pumpage	Reservoir	37,740,610	1,225,676	51,069	60–100	60–100	60–100
None	Pumpage	Direct	43,700,000	1,500,000	120,000	130	100–125	50–90
Not allowed	Pumpage	Both	37,500,000	1,250,000	54,000	70–130	30–90	30–90
.....	Pumpage	Direct	.....	.....	.....	55–110	.....	.....
None	Pumpage	Stand pipe	.....	.....	.....	115	90	40–115
None	Pumpage	Direct and stand pipe	60,000,000	2,000,000	83,333	70–140	60–120	60–120
None	Pumpage	Stand pipe	35,000,000	1,250,000	51,200	45–110	45–110	45–110
Check required	Pumpage	Direct and reservoir	116,300,000	3,876,667	161,528	50–100	45–85	30–85
None	Pumpage	Both	26,130,000	858,000	358,000	212	65	40–80
No	Pumpage	Both	.....	.....	.....	43–83	42–70	24–70
Not allowed	Pumpage	Direct	68,790,000	2,261,000	157,000	50–120	60–130	50–120
Check required	Pumpage	Direct	768,700,000	25,203,450	1,050,000	50	70–80	40–80
.....	Both	Reservoir	81,214,590	2,707,153	112,798	80–85	80–85	80–85
No	Pumpage	Stand Pipe	16,666,667	555,555	23,148	.....	40–100	40–100
.....	Pumpage	Both	24,333,333	811,111	33,796	55–120	55–120	55–120
None	Pumpage	Stand Pipe	52,500,000	1,750,000	72,916	.....	45	45

Information relative to source

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
Louisiana—con.								
New Orleans	Surface	.....	.....	.....	Mississippi River	Yes	Yes	Yes
Maine								
Brunswick	Wells	2½	18–30	.....	.....	.....	.....	.....
Maryland								
Baltimore	Surface	.....	.....	.....	River	Yes	Yes	No
Cumberland	Surface	.....	.....	.....	River	Yes	.....	.....
Hagerstown	Springs	.....	.....	.....	.....	Yes	Yes	No
Massachusetts								
Arlington	Surface	.....	.....	.....	.....	.....	.....	.....
Beverly	Surface	.....	.....	.....	Wenham Lake	No	No	.....
Boston	Surface	.....	.....	.....	Lake Cochituate, Sudbury and Nashua Rivers	No	No	No
Brockton	Surface	.....	.....	.....	Lake	No	No	No
Brookline	Wells	2½	40–95	.....	.....	No	No	No
Cambridge	Surface	.....	.....	.....	.....	No	No	No
Chelsea	Surface	.....	.....	.....	Metropolitan supply	No	No	No
Clinton	Surface	.....	.....	.....	Improved reservoir	No	No	No
Concord	Surface	.....	.....	.....	Ponds	No	No	No
Everett	Surface	.....	.....	.....	Metropolitan supply	No	No	No
Fall River	Surface	.....	.....	.....	Lake	No	No	No
Framingham	Surface	.....	.....	.....	Filter galleries	No	No	No
Gardner	Surface	.....	.....	.....	Crystal Lake	No	No	No
Gloucester	Surface	.....	.....	.....	Improved reservoir	No	No	No
Haverhill	Surface	.....	.....	.....	Ponds	.....	.....	.....
Lowell	Wells	2½	40	.....	.....	.....	.....	No
Lynn	Surface	.....	.....	.....	Art basins	No	No	No
Malden	Surface	.....	.....	.....	Metropolitan supply	No	No	No
New Bedford	Surface	.....	.....	.....	Lakes	No	No	No
Newburyport	Surface, wells and springs	.....	.....	.....	River	No	No	No
Northampton	Surface	.....	.....	.....	Mountain streams	No	No	No
Reading	Gallery	.....	.....	.....	Filter gallery	Yes	No	No
Somerville	Surface	.....	.....	.....	Metropolitan supply	No	No	No

of water supply, etc.—continued

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATE OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
Check required	Pumpage	Direct	506,400,000	16,880,000	703,333	72	60–65	60–65
Check required	Pumpage	Stand pipe	14,833,333	494,444	20,602	105	80	55–80
Check required	Both	Reservoir	137,913,731	4,597,090	191,545	90–260	30–100	30–260
.....	Gravity	Reservoir	180,000,000	6,000,000	250,000	115	100	50–60
.....	Gravity	.....	76,000,000	2,550,000	102,000	55–85	55–85	55–85
.....	Both	Stand pipe	32,314,500	1,077,150	44,881	.....	50–90	30–140
Check required	Pumpage	Direct	56,308,871	1,876,962	78,206	57	50	50
.....	Both	Reservoirs	3,486,900,000	116,230,000	4,842,916	59–110	59–110	59–110
None	Pumpage	Reservoir	89,763,805	2,943,075	122,628	48–90	48–90	48–90
None	Pumpage	Reservoir	82,385,305	2,708,558	112,856	40–110	40–100	40–110
Not allowed	Pumpage	Reservoir	319,000,000	10,400,000	430,000	68	55–60	55–60
.....	Gravity	.....	83,843,400	2,701,400	112,550	.....	48–53	41–96
No precautions	Gravity	.....	19,291,273	632,501	26,354	98	90	12–120
Check required	Both	Reservoir	17,500,000	583,333	24,305	40–110	40–100	30–80
.....	Gravity	Reservoirs	73,521,000	2,450,700	106,279	.....	45–90	45–90
Check required	Pumpage	Direct	.....	.....	.....	.....	.....	.....
Check required	Pumpage	Stand pipe	24,998,436	819,621	34,130	80–88	.....	.....
None	Pumpage	Reservoir	22,700,000	756,667	31,527	45–150	.....	.....
Check required	Pumpage	Reservoir	39,996,331	1,311,355	54,639	15–75	15–75	15–75
.....	Both	Reservoir	.....	.....	.....	110	30–120	30–120
Not allowed	.....	.....	163,766,843	5,369,405	223,725	70	70	25–70
None	Pumpage	Both	205,886,426	6,750,375	281,265	.....	50–65	50–70
.....	.....	.....	.....	.....	.....	.....	50–100	50–100
Check required	Pumpage	.....	252,500,000	8,280,000	345,000	25–90	25–90	25–90
None	Pumpage	Stand pipe	36,899,422	1,245,093	51,879	55–60	55–60	55–60
None	Gravity	.....	60,000,000	2,000,000	83,333	40–100	40–100	40–100
None	Pumpage	Stand pipe	7,000,000	234,368	9,765	90	78–90	45–90
Check required	.....	.....	203,320,500	6,777,350	282,390	.....	35–100	35–100

Information relative to source

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
Massachusetts—con.								
Springfield....	Surface	.....	.....	.....	Little River	Yes	No	No
Taunton.....	Ponds	.....	.....	.....	Lakeville ponds	No	.....	No
Waltham.....	Wells	40–60	28–30	4,000,000	.....	No	No	No
Winthrop.....	Surface	.....	.....	.....	Metropolitan supply	No	No	No
Michigan								
Adrian.....	Surface	.....	.....	.....	Creek	Yes	No	No
Alpena.....	Surface	.....	.....	.....	Lake Huron	Yes	Yes	No
Ann Arbor...	Wells and surface	2–8	.....	.....	.....	Yes	Yes	No
Battle Creek .	Surface	.....	.....	.....	Goguac Lake	No	Yes	No
Bay City.....	Surface	.....	.....	.....	Saginaw Bay	.....	Yes	No
Caldwell	Wells	6–40	50	3,000,000	.....	No	No	No
Detroit.....	Surface	.....	.....	.....	Detroit River	.....	Yes	No
Escanaba.....	Surface	.....	.....	.....	Green Bay	Yes	No	No
Flint.....	Surface	.....	.....	.....	Flint River	Yes	.....	.....
Holland.....	Wells	5	35–40	.....	.....	No	No	No
Ishpeming ...	Lakes	.....	.....	.....	.....	No	No	No
Jackson.....	Wells	6–14	350–400	.....	.....	No	No	No
Ludington ...	Surface	.....	.....	.....	Lake Michigan	.....	Yes	No
Marquette....	Surface	.....	.....	.....	Lake Superior	Yes	Yes	No
Mt. Clemons.	Wells	6–15	30–50	.....	.....	No	No	No
Owosso.....	Wells	.....	60–180	.....	.....	No	No	No
Saginaw.....	Surface	.....	.....	.....	Saginaw River	No	No	No
Traverse City	Surface	.....	.....	.....	Traverse Bay	Yes	Yes	No
Minnesota								
Austin.....	Spring and wells, deep rock	.....	.....	.....	.....	No	No	No
Duluth.....	Surface	.....	.....	.....	Lake Superior	Yes	Yes	No
Minneapolis..	Surface	.....	.....	.....	Mississippi River	Yes	Yes	No
St. Paul.....	Lakes and wells	.....	.....	.....	.....	No	No	No
Stillwater	Lakes, wells and springs	8	600	.....	.....	No	Yes	No
Virginia.....	Wells	8–12	350–826	2,016,000	.....	No	No	.....

of water supply, etc.—continued

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
Not allowed	Gravity	.....	320,650,000	10,660,000	444,167	.....	140	80
Check required	Pumpage	Direct	72,018,958	2,367,747	98,655	70–110	65–105	50–90
None	Gravity	Direct	85,500,000	2,850,000	118,750	38.8	75	75
.....	Gravity	Stand pipe	21,680,000	717,000	30,000	.....	72	72
None	Pumpage	Direct	43,924,109	1,464,139	61,006	50–100	40–90	40–90
.....	Pumpage	Direct	67,305,870	2,243,529	93,480	35–80	35–80	35–80
None	.....	Reservoir	67,163,400	2,238,780	93,282	90	65	35–90
Check required	Pumpage	Stand pipe	63,000,000	2,000,000	83,333	45	80–87	40–88
Check required	Pumpage	Direct	205,795,906	6,747,407	281,142	40–100	35–90	35–80
No	Pumpage	Direct	41,332,500	1,377,750	57,406	60–110	60–110	60–110
Check and gate required	Pumpage	Direct	3,227,906,908	105,833,013	4,409,709	47–100	28	20–40
None	Pumpage	Direct	58,750,000	1,958,333	81,597	60–125	60–125	60–125
Not allowed	Pumpage	Direct	124,847,947	4,104,590	171,024	60–120	60–120	60–120
Check required	Pumpage	Direct	24,631,920	793,652	33,069	100–60	90–55	80–55
None	Both	Direct	36,500,000	1,216,667	50,694	30–90	40	18
Check required	Gravity	Reservoir	85,618,530	2,853,951	118,914	60–100	60–100	50–55
Check required	Pumpage	Direct	34,500,000	1,116,600	46,525	40–80	.....	.....
None	Pumpage	Direct	68,927,500	2,209,000	92,041	90–125	25–110	70–105
Not allowed	Pumpage	Direct	27,000,000	800,000	33,500	50–140	45–135	40–130
None	Pumpage	Direct	16,534,160	551,139	22,964	45–90	.....	.....
No	Pumpage	Direct	294,607,710	9,820,257	409,177	40–95	35–70	.....
Check required	Pumpage	Direct	69,795,000	1,920,000	80,000	65	60	50
None	Pumpage	Direct	29,730,000	991,000	41,291	50–110	110	110
Not allowed	Pumpage	Reservoirs	232,650,000	7,648,000	318,667	.....	90–125	5–225
.....	Both	Reservoir	.....	.....	.....	100	60	60
None	Pumpage	Reservoir	400,500,000	13,350,000	556,250	15–95	40	.....
None	Both	Stand pipe	.....	.....	.....	95	60–70	20–95
None	Pumpage	Stand pipe	18,000,000	600,000	25,000	45–120	42–120	40–115

Information relative to source

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
Mississippi								
Jackson	Surface				Pearl River	No	No	No
Meridian	Surface and springs					Yes	No	No
Yazoo City	Wells	4–8	840	2,000,000		No	No	No
Missouri								
Kansas City	Surface				Missouri River	Yes	Yes	No
Excelsior City	Wells	8	85	952,000		No	No	No
Independence	Surface				Missouri River	Yes	Yes	No
Moberly	Surface and wells	9	500–510			No	No	
St. Joseph	Surface				Missouri River	Yes	Yes	No
St Louis	Surface				Mississippi River	Yes	Yes	Yes
Sedalia	Surface and wells	8–12	200–450		Small River	Yes	No	No
Springfield	Springs					Yes	Yes	No
Montana								
Billings	Surface				Yellowstone River	No	No	No
Butte	Surface				Mountain streams	Yes	No	No
Nebraska								
Omaha	Surface				Missouri River	Yes	Yes	No
New Hampshire								
Concord	Surface				Penacook Lake	No	No	No
Dover	Ponds, springs and wells	8	350			Yes	No	No
Keene	Lakes					No	No	No
Manchester	Surface				Lake Massabesic	No	No	No
New Jersey								
Bridgeton	Surface				Creek	Yes	Yes	No
Camden	Wells	8	60–130			No	No	No
Newark	Surface				Pequaumock River	No	No	No
Garfield	Wells	10	300			No	No	No
Passaic	Surface				Passaic River	Yes	Yes	No
Paterson	Surface				Passaic River	Yes	Yes	No
Perth Amboy	Wells	6	70			No	No	No
Phillipsburg	Surface				River and spring			
Rahway	Surface				Rahway River	Yes	Yes	No
New Mexico								
Albuquerque	Wells	6–26	60–700			No	No	No
Las Vegas	Surface				Gallinas River	No	No	No
New York								
Auburn	Surface				Owosco Lake	Yes	Yes	No

of water supply, etc.—continued

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
Check required	Pumpage	Both	97,500,000	3,250,000	135,415	100	30–75	30–75
None	Pumpage	Direct	77,128,500	2,600,000	108,000	75	75	50–72
None	Pumpage	Both	15,000,000	500,000	20,833	110–120	100	.....
None	Pumpage	Reservoir	862,228,521	28,341,759	1,180,907	150	Less	Elevation
None	Pumpage	Reservoir	10,000,000	333,333	13,888	135	60	50–125
None	Pumpage	Stand pipe	25,000,000	830,000	34,500	185	100	100–140
None	Pumpage	Direct	90,000,000	3,000,000	125,000	90	55	55
Sealed valves	Pumpage	Reservoir	273,365,000	9,112,167	379,673	140	95–120	15–90
.....	Pumpage	Both	2,463,000,000	82,100,000	3,420,833	85–125	50	15–85
None	Pumpage	Reservoir	63,000,000	2,375,000	98,958	107–150	40–90	40–90
No	Pumpage	Stand pipe	125,388,150	4,101,599	170,899	155	40–60	40–60
.....	Pumpage	Reservoir	75,000,000	2,500,000	107,500	80	60–70	45–65
None	Both	Reservoir	270,000,000	9,000,000	375,000	.....	105	60–150
None	Pumpage	Reservoir	627,500,000	20,900,000	870,000	115–140	90–120	50–125
Gates	Both	Reservoir	90,000,000	3,000,000	125,000	45–85	48–88	45
Checks and gates	Pumpage	Reservoir	16,787,500	550,890	22,950	85	85	85
None	Gravity	.....	.....	.....	.....	.....	60	45–80
Checks and gates	Pumpage	Reservoirs	123,659,454	4,121,982	171,749	42	.....	130
None	Pumpage	Stand pipe	42,300,000	1,380,000	57,500	15	.....	55
Check valves	Pumpage	Direct	366,824,666	11,985,739	499,406	49½	35	40
None	Gravity	.....	.....	.....	.....	50	to	150
No	Pumpage	Direct	.....	.....	.....	80	75	60–75
Check valves	Pumpage	Reservoir	159,000,000	5,300,000	220,833	60	40 to	100
Check	Pumpage	Reservoir	304,500,000	10,150,000	422,916	60	40	60
None	Pumpage	Stand pipe	202,658,190	6,755,273	281,469	110	45	35
.....	Both	Reservoir	39,666,667	1,322,222	55,092	30	to	112
None	Pumpage	Stand pipe	60,386,283	2,012,876	83,869	.....	45	.....
None	Pumpage	Direct	.....	.....	.....	90	90	40–90
None	Gravity	.....	30,000,000	1,000,000	41,667	60	to	130
Check valves	Pumpage	Direct	200,650,500	6,688,350	278,681	60–100	60–130	25–135

Information relative to source

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
New York—con.								
Binghamton	Surface	.....	.....	.....	Susquehanna River	Yes	Yes	No
Buffalo.....	Surface	.....	.....	.....	Lake Erie.....	No	No	No
Canandaigua.	Surface	.....	.....	.....	Canandaigua Lake	No	No	No
Cortland.....	Surface	.....	.....	.....	Springs	No	No	No
Dunkirk.....	Surface	.....	.....	.....	Lake Erie	No	No	No
Elmira.....	Surface	.....	.....	.....	River and improved reservoir	Yes	Yes	No
Geneva	Surface	.....	.....	.....	Seneca Lake	Yes	No	No
Glen Falls....	Surface	.....	.....	.....	Improved reservoir	No	No	No
Gloversville..	Surface	.....	.....	.....	Improved reservoir	No	No	No
Huntington..	Wells	8	45–65	.....	.....	No	No	No
Jamestown...	Wells	6–8	95	6,000,000	.....	No	No	No
Kingston.....	Surface	.....	.....	.....	Mountain streams	Yes	No	No
Little Falls...	Surface	.....	.....	.....	Mountain streams	No	No	No
Mt. Vernon ..	Surface	.....	.....	.....	2 rivers	Yes	Yes	No
New Rochelle	Surface and wells	4½	26–90	.....	Hutchinson River	No	Yes	No
Newburgh ...	Surface	.....	.....	.....	Washington Lake	No	No	No
North Tonawanda.....	Surface	.....	.....	.....	Niagara River	No	No	No
Ogdensburg..	Surface	.....	.....	.....	St. Lawrence River	Yes	No	No
Olean	Wells	5½–15	45	.....	.....	No	No	No
Ossining.....	Surface	.....	.....	.....	Improved reservoir	Yes	No	No
Peekskill.....	Surface	.....	.....	.....	Lakes and brooks	Yes	No	No
Rensselaer ...	Surface	.....	.....	.....	Hudson River	Yes	Yes	No
Seneca Falls..	Surface	.....	.....	.....	Cayuga Lake	Yes	Yes	No
Schenectady .	Wells	8–50	45–60	18,000,000	.....	No	No	No
Troy.....	Surface	.....	.....	.....	Tomhannock Creek	No	Yes	No
Utica.....	Surface	.....	.....	.....	West Canada Creek	Yes	Yes	.....
Waterford....	Surface	.....	.....	.....	Hudson River	No	No	No
Watertown...	Surface	.....	.....	.....	Black River	Yes	Yes	No
White Plains.	Surface and wells	8–25	112–155	.....	.....	No	No	No
Yonkers.....	Surface	.....	.....	.....	Saw Mill River	Yes	Yes	No

of water supply, etc.—continued

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
None	Pumpage	Both	215,852,190	7,195,073	299,794	65–80	.....	.....
Not allowed	Pumpage	Both	4,299,419,993	134,927,303	5,621,970	50–75	30	30
Checks	Pumpage	Reservoir	26,130,000	900,000	37,500	121	to	45
Checks	Pumpage	Stand pipe	35,496,564	1,163,822	48,492	70	75	75
None	Pumpage	Direct	130,618,389	4,353,946	181,414	60–125	.....	.....
.....	Pumpage	Reservoir	178,000,000	5,933,333	247,222	41	70	70
No	Both	Reservoir	47,819,250	1,593,975	66,415	110	85	12–70
None	Gravity	.....	67,500,000	2,500,000	104,167	80	to	125
Checks	Gravity	.....	60,000,000	2,000,000	83,333	135	to	45
None	Pumpage	Reservoir	7,000,000	275,000	34,000	44–75	51	50–105
Check	Pumpage	Reservoir	90,000,000	3,000,000	125,000	125	125–150	50–100
No	Gravity	.....	.....	.....	.....	45	to	130
Flush system	Gravity	.....	105,000,000	3,500,000	146,667	40	to	135
None	Pumpage	Stand pipe	95,630,145	3,187,671	132,820	130	50	30–50
None	Both	Stand pipe	96,711,017	3,170,853	132,119	110–65	35–100	35–100
None	Both	Reservoir	138,130,000	4,455,806	186,569	50–60	40–100	40–60
None	Pumpage	Direct	162,396,085	5,413,203	225,550	40	80	.....
.....	Pumpage	Direct	75,000,000	2,500,000	104,167	55–75	45 to	65
Check valves	Both	Reservoir	48,758,997	1,625,299	67,720	112	105	105
None	Pumpage	Reservoir	16,350,000	539,142	22,464	140	60–140	50–80
None	Pumpage	Both	90,000,000	3,000,000	125,000	160	100	80–160
Check valve	Pumpage	Reservoir	45,000,000	1,500,000	62,500	125	100–120	50–100
Check valve	Pumpage	Stand pipe	27,000,000	900,000	37,500	85	50	35–50
None	Pumpage	Direct	332,608,750	10,935,082	455,628	97	85	10–85
None	Gravity	.....	.....	18,000,000 maximum	.....	.....	50–60	20–120
Check valves	Pumpage	Direct and reservoir	233,250,000	7,775,000	323,958	100	to	40
None	Pumpage	Direct	12,622,916	414,068	17,152	82–100	75–85	50–85
Check valves	Pumpage	Reservoirs	155,035,000	5,083,150	211,798	.....	.....	.....
None	Pumpage	Stand pipe	42,246,630	1,408,221	58,675	90	90–95	30–90
Check valves	Pumpage	Both	254,016,250	8,617,675	359,069	Static	pressure	

Information relative to source

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
North Carolina								
Asheville	Surface				Mountain streams	No		
Durham	Surface				Eno River	Yes	Yes	
Elizabeth City	Surface				Knobbs Creek	Yes	Yes	Yes
Wilmington	Surface				River	Yes	Yes	No
North Dakota								
Grand Forks	Surface				Red Lake River	Yes	Yes	No
Ohio								
Canton	Wells					No	No	No
Cincinnati	Surface				Ohio River	Yes	Yes	No
Columbus	Surface				Scioto River	Yes	Yes	Yes
Conneaut	Surface				Lake Erie	Yes	No	No
Delaware	Wells	4–6–8	24–225			No	No	No
Elyria	Surface				Lake Erie	No	No	No
Fremont	Surface				Sandusky River	No	No	No
Marion	Wells	6–10	100–200			No	No	No
Massillon	Wells	6	200	1,500,000		No	No	No
Middletown	Wells	6–25	35			No	No	No
Newark	Surface			5,000,000	Infiltration intake	No	No	No
Piqua	Surface				Miami and Erie Canal	No	No	No
Springfield	Well	30	20			No		
Warren	Surface				Mahoming River	Yes	Yes	No
Youngstown	Surface				Mahoming River	Yes	No	No
Zanesville	Surface				Muskingum	Yes	Yes	No
Oklahoma								
Guthrie	Surface				Cottonwood River	Yes	No	No
Muskogee	Surface				River	Yes	Yes	No
Oklahoma City	Surface				North Canadian River	Yes	Yes	No
Shawnee	Surface				North Canadian River	Yes	No	No
Oregon	Surface				Cañon Creek	No	No	No
Keppner	Wells	8–12	700			No	No	No
Portland	Surface				River	No	No	No
Pennsylvania								
Allentown	Springs			14,000,000		No	No	No
Altoona	Surface and springs					No	No	No

of water supply, etc.—continued

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
.....	Gravity	.....	45,666,667	1,522,222	63,426	Average 150		
Check valves	Pumpage	Reservoirs	34,000,000	1,133,333	47,222	60	to	120
None	Pumpage	Stand pipe	7,500,000	240,000	12,500	35–110	25–100	25–90
None	Pumpage	Direct and stand pipe	52,225,084	1,717,072	71,544	80	75	64
None	Pumpage	Direct	26,830,000	882,000	36,750	40	to	110
.....	Pumpage	Direct	214,000,000	7,000,000	291,667	95	70	60
None	Pumpage	Both	1,568,922,400	51,440,000	2,143,000	10	to	150
Not allowed	Pumpage	Reservoir	501,897,000	16,456,000	685,667	80	55–65	15–70
.....	Pumpage	Stand pipe	41,000,000	1,353,000	56,500	100–185	50–135	40–125
None	Pumpage	Direct and stand pipe	30,350,000	934,000	38,916	60	to	85
None	Pumpage	Direct	54,237,528	1,809,584	75,399	125	40	40
.....	Both	Stand pipe	24,000,000	800,000	33,333	55	55	42
.....	Pumpage	Direct and reservoir	48,765,450	1,552,181	64,674	70–130	40 to	100
Check valves	Pumpage	Stand pipe	27,454,714	900,155	37,506	90–120	80–110	60–90
Check valves	Pumpage	Direct	82,500,000	2,750,000	114,583	60–110	.....	.....
.....	Pumpage	.....	75,000,000	2,500,000	104,167	110	110	110
.....	Gravity	Direct	.....	.....	.....	50	35 to	40
Double check	Pumpage	Stand pipe	194,000,000	6,500,000	256,500	95	75	65
.....	Pumpage	Stand pipe	27,761,000	978,000	38,900	60–150	55–145	.....
Check gates	Pumpage	Stand pipe	293,910,000	9,797,000	408,209	90–140	80–85	25–90
None	Pumpage	Both	180,000,000	6,000,000	250,000	85–138	80–125	40–138
.....	Pumpage	Stand pipe	.....	.....	.....	70	to	130
No	Pumpage	Direct	105,000,000	3,500,000	146,667	125	75	75
Check valve	Pumpage	Direct	202,968,870	6,765,629	281,901	80	75	65
None	Pumpage	Stand pipe	22,000,000	733,333	30,555	90–140	55–100	50–90
No	Gravity	.....	.....	.....	.....	87	87	87
No	Pumpage	Direct	.....	.....	.....	85–40	85–40	85–40
No	Gravity	.....	Waste included	67,500,000	.....	40	to	90
None	Gravity	Stand pipe	240,413,569	7,844,212	328,092	35	to	100
.....	Gravity	.....	145,815,000	4,419,380	184,140	69	60	60

Information relative to source

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
Pennsylvania—con.		*inches*	*feet*					
Bradford	Wells and surface	10	165	2,000,000	.....	No	No	No
Erie	Lake Erie	.....	.....	.....	.....	Yes	Yes	No
Duquesne	Wells	12	70	.....	Rock wells	No	No	.....
Johnstown	Mountain streams	.....	.....	.....	.....	Yes	Yes	No
McKeesport	Youghiogheny River	.....	.....	.....	.....	Yes	.....	Yes
Philadelphia	Schuylkill River	.....	.....	.....	.....	Yes	Sometimes	No
Lebanon	Springs	.....	.....	.....	.....	No	No	No
Meadville	Wells	5¼	60	.....	Shallow gravel	No	No	No
Nazareth	Wells and mountain	6-8	450	.....	Deep rock	No	No	No
New Holland	Springs	.....	.....	.....	.....	No	No	.....
North East	Springs	.....	.....	.....	.....	Yes	Yes	No
Reading	Surface and creeks	.....	.....	.....	.....	Yes	No	No
Sharon	Shenango River	.....	.....	.....	.....	Yes	Yes	No
Shenandoah	Wells and streams	10	995	.....	Deep rock springs	No	No	No
Sunbury	Surface	.....	.....	.....	Little Shamokin Creek	Yes	.....	.....
Wilkinsburg	Surface	.....	.....	.....	Allegheny River	Yes	Yes	No
Williamsport	Surface and wells	30	30	13,000,000	Mountains and streams	No	No	No
Rhode Island								
Providence	Surface	.....	.....	.....	Pawtuxet River	Yes	.....	No
South Carolina								
Charleston	Surface	.....	.....	.....	Improved reservoir	Yes	Yes	No
Columbia	Surface	.....	.....	.....	Congaree River	Yes	Yes	No
South Dakota								
Mitchell	Wells	8	550-800	701,280	Deep rock	No	No	No
Tennessee								
Clarksville	Surface	.....	.....	.....	Cumberland River	Yes	Yes	No
Jackson	Wells	6	100	100,000	.....	No	No	.....
Memphis	Wells	.....	500	.....	Artesian	No	Sometimes	.....
Nashville	Surface	.....	.....	.....	Cumberland	Yes	Yes	No

of water supply, etc.—continued

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
.....	.....	.....	.....	2,000,000	.....	85	85	85
Check valve	Pumpage	Direct and reservoir	478,213,528	15,679,132	653,297	92–125	35–92	35–92
.....	Pumpage	Stand pipe	22,000,000	750,000	26,750	184	175	50–175
Check and double gate	Gravity tanks and pumpage	.....	308,400,000	10,280,000	430,000	70	to	80
.....	Gravity tanks and pumpage	Reservoir	117,756,900	3,871,460	161,298	60–130	60 to	120
.....	Pumpage	Reservoir	9,732,000,000	319,000,000	13,200,000	35	to	170
.....	Gravity	Sometimes reservoir	68,000,000	2,280,000	950,000	65	65	65
None	Pumpage	Reservoir	59,789,712	1,965,689	819,065	130	115	30–115
None	Gravity	.....	39,000,000	1,300,000	541,666	50	to	120
.....	Gravity	.....	.....	.....	.....	50	50	50
None	Gravity	.....	13,500,000	450,000	187,500	80	to	90
Check	Pumpage and gravity	Reservoir	435,599,638	14,321,084	596,712	120	50	55
None	Pumpage	Reservoir	73,467,016	2,449,000	102,000	120	to	135
None	Pumpage and gravity	Reservoir	53,160,000	1,740,000	725,000	90	80	80
None	Pumpage	Partly reservoir	78,840,432	2,628,014	109,500	80	55–100	55–100
Check	Both	.....	255,778,500	8,525,950	355,250	.....	30–210	100–185
None	Both	Direct	180,000,000	6,000,000	250,000	70	50	25–50
Not permitted	Both	Partly reservoir	533,388,506	17,483,148	728,173	.....	65–73	18–97
.....	Pumpage	Direct	150,000,000	5,000,000	203,000	120	45	45
Hand valve and check	Pumpage	Stand pipe	135,000,000	4,500,000	187,500	125	55–110	55–110
None	Pumpage	Reservoir	9,000,000	300,000	12,500	75	to	125
Check	Pumpage	Direct	285,000,000	9,500,000	400,000	40	to	50
No connection	Pumpage	Direct	80,500,000	2,550,000	19,000	80	55	70–20
Check	Pumpage	Reservoir	409,570,440	13,652,348	568,847	60–75	50	40
.....	Gravity	Reservoir	368,820,434	12,125,603	520,000	160	90–100	30–60

Information relative to source

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
Texas								
Galveston	Wells	7	800	8,000,000	Artesian	No		
Denison	Wells and surface				Rain fall, shallow gravel	No		
El Paso	Wells	8–14			Deep	No		
Laredo	Surface				Rio Grande River	Yes	No	
San Antonio	Wells	6–10	630–880	50,000,000	Artesian	No	No	No
Temple	Surface				River	Yes	Some	
Waco	Wells		40 and 1800		Shallow and artesian	No	No	No
Utah								
Ogden	Surface				Mountain streams	No	No	No
Salt Lake City	Surface				Springs and mountain streams	No	No	No
Vermont								
Burlington	Surface				Lake Champlain	Yes	Yes	
Manchester	Springs				Mountain springs	No	No	No
Rutland	Surface				Creek and brooks	Yes	Yes	No
Virginia								
Lynchburg	Surface				Pedlar River	No	No	No
Richmond	Surface				River	Yes	No	
Roanoke	Surface				Springs			
Washington								
Anacortes	Surface				3 small lakes	No		
Hoquiam	Surface				Mountain streams	No	No	No
Marcus	Surface				Columbia River	No	No	No
N. Yakima	Surface				Natchez River	Yes	Yes	No
Seattle	Surface				Cedar River	No		
Spokane	Wells	25	40			No	No	
Tacoma	Wells	10–12 20 feet	46–200		Deep wells	No	No	
Walla Walla	Surface				Mountain streams	No		

of water supply, etc—continued

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
.....	Both	Reservoir	105,000,000	3,500,000	145,833	40	to	100
None	Pumpage	Stand pipe	30,000,000	1,000,000	41,666	175	80	80
None	Pumpage	Direct and reservoir	125,000,000	4,000,000	166,666	75	85	75
None	Pumpage	Stand pipe	31,000,000	1,200,000	69,000	63–85	30–55	30–55
Not connected	Pumpage	Direct	410,939,239	13,510,331	562,930	80–90	75–90	40–65
None	Pumpage	Partly direct reservoir	34,000,000	1,133,333	555,055	60–120	55 to	110
None	Pumpage	Reservoir	187,500,000	6,250,000	260,415	80	65	25–65
None	Gravity	Direct	.....	.....	.....	90	90	90
None	Gravity	Reservoirs	660,000,000	22,000,000	916,666	85	to	190
Check valves	Pumpage	Reservoirs	414,310,640	13,812,354	575,514	125	75–125	10–75
None	Gravity	Direct	.....	.....	.....	.....	.....	.....
.....	Gravity	Reservoir	90,000,000	3,000,000	125,000	95	60 to	95
Check	Gravity	.....	.....	.....	.....	.....	100–150	12–50
No connection	Pumpage	Reservoirs and stand pipe	437,513,644	14,638,244	609,927	70–115	20–80	16–65
.....	Pumpage	Reservoir	128,797,839	4,222,880	175,953	.....	75	50–75
None	Gravity	.....	.....	.....	.....	.....	80	.....
None	Both	Reservoirs	50,886,067	1,696,202	706,700	90	90	90
.....	Pumpage	Partly reservoir	.....	.....	.....	80	80	80
No connection	Both	.....	.....	.....	.....	80	80	80
Not allowed	Both	Reservoir and stand pipe	.....	.....	.....	10	to	160
Check	Pumpage	Reservoir and stand pipe	973,880,750	32,496,025	1,354,011	30	to	165
Check	Pumpage	Direct reservoir and stand pipe	450,000,000	15,000,000	625,000	84–90	105–175	20–60
.....	Gravity	.....	.....	175 gallons per capita, 110		.....	.....	.....

Information relative to source

CITY	SOURCE OF SUPPLY	IF FROM WELLS			SURFACE SUPPLY	IS WATER TREATED?	IS HYPOCHLORIDE OF LIME USED?	IS SOFTENING SYSTEM USED?
		Diam.	Depth	Quantity daily				
		inches	*feet*					
Wisconsin								
Ashland	Surface	.....	.....	.....	Lake Superior	Yes	Yes	No
La Crosse	Surface	.....	.....	.....	Mississippi River	No	No	.....
Madison	Wells	8–10	700–1000	.....	.....	No	No	No
Marinette	Surface	.....	.....	.....	Lake Michigan	Yes	Some	No
Racine	Surface	.....	.....	.....	Lake Michigan	Yes	Yes	.....
Superior	Wells	6–8	.....	.....	.....	Yes	No	No
Waukesha	Wells	6	860	Each 500,000	.....	No	No	.....
Beloit	Wells	4–30	40–88	8,000,000	.....	No	No	No
Green Bay	Wells	8–20	850–933	.....	Artesian	No	.....	.....
Milwaukee	Surface	.....	.....	.....	Lake Michigan	Yes	Yes	No
Cheyenne	Surface	.....	.....	.....	Mountain streams	No	No	No

of water supply, etc.—concluded

NO. 9	GRAVITY OR PUMPAGE	TO STAND PIPE OR RESERVOIR	AVERAGE RATES OF CONSUMPTION			PRESSURE		
			One month	One day	One hour	Station	Business district	Residence district
			gallons	*gallons*	*gallons*	*pounds*	*pounds*	*pounds*
Check	Pumpage	Direct	36,034,457	1,181,060	487,500	65–120	45–120	20–120
.....	Pumpage	Direct	84,057,591	2,755,986	.....	60	to	100
Check	Pumpage	Stand pipe	59,600,000	1,980,000	150,000	85–125	70 to	110
Check	Pumpage	Direct	40,000,000	1,300,000	.....	40	to	110
Check	Pumpage	Direct and stand pipe	104,800,000	3,400,000	.....	55	to	100
No connection	Pumpage	Direct	61,300,000	2,010,000	837,500	65–135	55–110	55–110
.....	Pumpage	Direct	.....	.....	.....	65–100	68	30–65
Check	Pumpage	Stand pipe	65,000,000	2,000,000	833,333	55	50–55	35–45
No connection	Pumpage	Reservoir	44,218,733	1,449,802	.....	40	40	40
Check	Pumpage	Direct reservoir and stand pipe	145,046,465	47,556,310	2,000,000	68–100	50–60	20–50
None	Gravity	.....	111,000,000	3,610,000	151,000	110	to	120

Information relative to public fire service

TOWN	PER CENT OF FIRES WHERE STEAMERS ARE USED	DO YOU HAVE SEPARATE HIGH PRESSURE SYSTEM	IF SO, TO WHAT EXTENT	ANNUAL REVENUE		WHO MAINTAINS HYDRANTS AND VALUES?	HYDRANT CONNECTIONS			DESCRIPTION OF FIRE HYDRANT			DO HYDRANTS CONFORM TO THE NATIONAL STANDARD
				Per hydrant	Total		4″	6″	8″ and larger	4½″ steamer connection and no 2½″ hose connection	One 4½″ steamer connection and one or more 2½″ hose connection	One or more 2½″ hose connection and no 4½″ steamer connection	
Anniston, Ala		No		$45.00	$5,850.00	Water company	130					130	Yes
Bessemer, Ala	None	No		50.00	5,150.00	Water company	40	63		40		63	Yes
Mobile, Ala	10	No		No hydrant	Rental	Water department	727	247			50	924	Yes
Phoenix, Ariz	5	No		No hydrant	Rental	Water department	200	80			280		Yes
Fort Smith, Ark	Used but not given	No		$40.00 to 60.00	$28,000.00	Water department							
Pine Bluff, Ark	None	No		40.00 to 43.00	12,924.24	Water company	275	37			27	285	
Pomona, Cal	None	Yes	In business district only	3.00	735.00	City of Pomona						245	Yes
Sacramento, Cal		No		No hydrant	Rental	Water department	560			8	132	420	
San Diego, Cal	No data	No		$25.00	$19,650.00	Water department	157	314	314		314	471	Yes
San Francisco, Cal	No data	Yes	72 miles	2.50	11,052.50	Fire department and company jointly	2,627	1,439	355–2½″ Con.	2–3″			No
Stockton, Cal	100	No		12.00	3,000.00	City	175	175	75	No detail	No detail		
Colorado Sprgs, Col	None	No		30.00	13,860.00	Water department	318	174	12		146	358	Yes
Denver, Col	10	No		22.50	73,620.00	Water company		3,772			3,772		Yes
Bristol, Conn	None	No			1,750.00	Water company						130	Yes
Hartford, Conn		No		2.00	2,734.00						341	1,026	

Manchester, Conn	None	No		$30.00	$1,020.00	Water company	24	10				34	Yes
Meriden, Conn	All if necessary	No				Water department							Yes
New Britain, Conn	2	Yes	In high localities			Water department		608				608	Yes
New Haven, Conn	All	No				Water department						1,000	
New London, Conn	Very small	No				Water department	7	356				363	Nearly
Stamford, Conn	10	No		15.40	3,600.00	City of Stamford	No Record, Owned by city						
Wilmington, Del	No Record	No				Water department		935			935		Yes
Washington, D. C.	100	No				Water department		1,445	1,666		1,666	1,445	
Jacksonville, Fla	Most fires	Yes	In business districts	30.00	20,550.00	Water department		700				700	Yes
Miami, Fla	1	No		No hydrant	Rental	City of Miami	105						Yes
Athens, Ga	None	No			Free tax	Water department		248			9	239	Yes
Atlanta, Ga	No data	No		$25.00		Water department							Yes
Macon, Ga	25	No		37.50	$18,637.50	Water company	10	487			348	149	Yes
Downey, Idaho	None			12 and 60		Water company	2					2	Yes
Aurora, Ill	1 time in 7 years	No				Water department	1	542	66			609	Yes
Champaign, Ill	None	No		40 and 35	12,300.00	Water company		351				351	Yes
Decatur, Ill	1	No				Water department	300	314			150	464	No
Elgin, Ill	None	No		10.00	4,830.00	Water department		482	1			483	Yes
Dixon, Ill	None	No		35.00	6,860.00	Water company	195	1				196	Yes
Freeport, Ill	None	No		62.50	12,500.00	Water company	118	82				200	No
Kankakee, Ill	None	No		40.00	9,560.00	Water company	239					239	Yes
Lake Forest, Ill	None	No		Rates	Undecided	City	115					115	Yes
Lincoln, Ill	None	No		$35.00	6,650.00	Water company	190					190	Yes
Oak Park, Ill	None	No		20 and 10	12,360.00	Water department	305	485			344	446	Partly
Peoria, Ill	2	No		52–41.60–25	50,299.00	Water company	616	655	110		165	1,216	Yes
Quincy, Ill	100	No		43–30 20	13,640.00	Water company	3	404		53	354		No
Rockford, Ill	100	No				Water department	432	217			334	315	Yes
Springfield, Ill		No				Water department	863	863			21	842	No
Streator, Ill	None	No		45 and 35	10,850.00	Water company	190	88			112	166	No
Anderson, Indiana	None	No		39.84	15,000.00	Water department	12	367			80	299	No
Brazil, Ind	None	No				Water department	136					136	

Information relative to public fire service—Continued

TOWN	PER CENT OF FIRES WHERE STEAMERS ARE USED	DO YOU HAVE SEPARATE HIGH PRESSURE SYSTEM	IF SO, TO WHAT EXTENT	ANNUAL REVENUE		WHO MAINTAINS HYDRANTS AND VALUES?	HYDRANT CONNECTIONS			DESCRIPTION OF FIRE HYDRANT			DO HYDRANTS CONFORM TO THE NATIONAL STANDARD
				Per hydrant	Total		4"	6"	8" and larger	4½" steamer connection and no. 2½" hose connection	One 4½" steamer connection and one or more 2½" hose connection	One or more 2½" hose connection and no. 4½" steamer connection	
Elkhart, Ind	9	No		$40.00	$13,100.00	Water company	305	38				343	Yes
Evansville, Ind	5	No				Water department	50	684			21	713	Yes
Fort Wayne, Ind	All fires	No				Water department	15	808	18				Yes
Gary, Ind	None	No		50 and 40	14,470.00	Water company		343			40	303	Yes
Hammond, Ind	100	No		Taxes approx.	12,000.00	Water department	250	106	1		357		Yes
Indianapolis, Ind	1	No		$45.00		Water company							Yes
Jeffersonville, Ind	None	No		60–52.10–50	7,790.00	Water company	2	147				149	Yes
Kokomo, Ind		No		25.00	9,925.00	Water company						390	
Logansport, Ind	None	No				Water department	217	217				217	Yes
Marion, Ind	None	No				Water department	122	224				346	Yes
Mishawaka, Ind	None	No		Taxes approx.	9,000.00	Water department	125	50	1			176	Yes
New Castle, Ind						Water department	120	5				125	Yes
Richmond, Ind	None	No		$55 and 49	15,875.00	Water company		325				325	Yes
South Bend, Ind	None	No				Water department	23	997				1,020	Yes
Terre Haute, Ind	½	No		40.00	43,120.00	Water company	300	778			3	1,075	Yes
Vincennes, Ind	None	No		33.33⅓	9,400.00	Water company		275			20	255	Yes
Valparaiso, Ind	None	No		50.00	7,100.00	Water company						142	
Washington, Ind	None	No		34.25	6,600.00	Water company	190	4				194	No
Burlington, Ia	None	No		Taxes approx. ave.	19,000.00	Water company	283	191				474	No

Clinton, Ia		No		$42.00	$16,270.00	Water company						386	
Council Bluffs, Ia	None	No		56.00	20,344.00	Water company	300	62			31	331	Yes
Creston, Ia	None	No		55.00	7,850.00	Water company	142					142	Yes
Davenport, Ia	None	No		38.00	29,184.00	Water company	220–5	544	4			768	No
Des Moines, Ia	None	No		33.50	55,741.00	Water company	810	855			20	1,645	Yes
Iowa City, Ia		No		45.00	9,360.00	Water company	208						
Keokuk, Ia		No		50.00	8,000.00	Water company						160	
Muscatine, Ia	None	No				Water department	25	332				357	No
Ottumwa, Ia	None	No				Water department	100	182				282	
Sioux City, Iowa	5	No				Water department	350	119			119	350	No
Waterloo, Ia	None	No		By taxes approx. ave.	17,000.00	Water department	254	201			27	428	Yes
Atchison, Kan	Nearly all	No		$33.20	6,040.00	Water company	82	100			84	98	Yes
Fort Scott, Kan	None	No		20.00	4,000.00	Water department	200					200	Yes
Hutchison, Kan	None	No											
Lawrence, Kan	None	No			5,400.00	Water company	69	102				170	No
Parsons, Kan	None	No		60 and 50	7,950.00		149					149	
Pittsburg, Kan	None	No		46 and 45	11,530.00	Water department	138	116			17	237	Yes
Wichita, Kan		No		37.50	25,975.00	Water company						672	
Danville, Ky	None	No				Water department	108	12				120	No
Henderson, Ky	None	No				Water department	8	181				189	Yes
Lexington, Ky	None	No		50.00	30,250.00	Water company	543	62			18	587	No
Louisville, Ky	100	No				Fire department		1,955		1,955			Yes
Newport, Ky	None	No				Water department	230	30				260	Yes
Alexandria, La	None	No				Water department	126					126	
Baton Rouge, La	None	No		50.00	6,850.00	Water company						137	Yes
Lake Charles, La	None	No		60 and 40	6,400.00	Water company	141					141	
New Orleans, La	Small	No				Water department	4,443	660			686	4,417	No
Brunswick, Maine		No		40.00	4,920.00	Water department		122	1		93	30	Yes
Baltimore, Md					7,541.67						324		
Cumberland, Md	None	No				Water department						253	
Hagerstown, Md	10	No		17.26 and 45	3,070.00	Water company	41	63			11	93	Yes
Arlington, Mass	None	No			7,000.00	Water department		430			75	355	Yes
Beverly, Mass	Very small	No				Water department	196	259	14		469		Yes

Information relative to public fire service—Continued

TOWN	PER CENT OF FIRES WHERE STEAMERS ARE USED	DO YOU HAVE SEPARATE HIGH PRESSURE SYSTEM	IF SO, TO WHAT EXTENT	ANNUAL REVENUE		WHO MAINTAINS HYDRANTS AND VALUES?	HYDRANT CONNECTIONS			DESCRIPTION OF FIRE HYDRANT			DO HYDRANTS CONFORM TO THE NATIONAL STANDARD
				Per hydrant	Total		4″	6″	8″ and larger	4½″ steamer connection and no 2½″ hose connection	One 4½″ steamer connection and one or more 2½″ hose connection	One or more 2½″ hose connection and no 4½″ steamer connection	
Boston, Mass								8,234					
Brockton, Mass		No				Water department		1,054			1,054		No
Brookline, Mass	25	No				Water department		744	1		745	745	
Cambridge, Mass	10	No				Water department		1,121	4		1,125		No
Chelsea, Mass	10	Yes	Not Ext.		$2,492.00	Water department	6	260	45		311		Yes
Clinton, Mass	100	No		$25.00	4,625.00	Water department	32	158			100	90	Yes
Concord, Mass	None	No		12.00	2,520.00	Water department	94	130			224		
Everett, Mass	3	Yes	Small satisfactory			Water department		559			559		Yes
Fall River, Mass	Rarely used	No				Water department		1,408			1,408		Yes
Framingham, Mass	10	No		27.50	6,600.00	Water department	90	148	1		149	90	No
Gardner, Mass	Respond to all fires	Yes	Gravity satisfactory		6,800.00	Water department	77	105	1	105		77	No
Gloucester, Mass		No		Approp.	4,000.00	Water department		329			329		Yes
Haverhill, Mass	Very small	Yes	Satisfactory			Fire department							Yes
Lowell, Mass		No				Water department		1,275	8			1,283	Yes
Lynn, Mass	Very small	No				Water department	30	1,130	26		1,183	3	
Malden, Mass		Yes	Business and Mfg. Dist.			Water department	353	155	1		509		Yes
New Bedford, Mass	Respond to all fires	No				Water department	150	1,045	5	71	1,123	6	No
Newburyport, Mass	100	No			5,000.00	Water department		245			245		
Northampton, Mass		No				Water department	303	102				405	Yes

Reading, Mass	5	No	.....	$30.00	$5,610.00	Water department	.....	188	4	.....	180	12	Yes
Somerville, Mass	.....	No	.....	.....	.....	Water department	200	889	10	.....	899	200	.....
Springfield, Mass	.....	No	.....	.....	.....	Water department	482	879	78	.....	1,466	.....	Yes
Taunton, Mass	1	No	.....	.....	.....	Water department	87	742	3	.....	3	829	Yes
Waltham, Mass	100	No	.....	6.00	2,856.00	Water department	.....	476	.....	.....	.....	.....	Yes
Winthrop, Mass	10	No	.....	.....	3,000.00	Water department	80	161	.....	.....	229	12	Yes
Adrian, Mich	None	No	.....	50.00	7,950.00	Water company	159	.....	.....	.....	.....	159	Yes
Alpena, Mich	1	No	.....	40.00	9,560.00	Water department	241	.....	.....	.....	5	236	Yes
Ann Arbor, Mich	Rarely	No	.....	40 and 45	10,000.00	Water company	.....	246	12	.....	258	.....	Yes
Battle Creek, Mich	1	No	.....	.....	.....	Water department	260	422	1	.....	300	382	Yes
Bay City, Mich	1	No	.....	.....	.....	Water department	832	60	.....	.....	.....	892	No
Coldwater, Mich	50	No	.....	.....	5,000.00	Water department	12	86	22	.....	12	108	Yes
Detroit, Mich	60	Yes	7 miles satisfactory	.....	.....	Fire department	.....	5,699	150	5,849	.....	.....	Yes
Escanaba, Mich	40	No	.....	50 and 38	7,412.00	Water company	94	127	.....	.....	.....	221	Yes
Flint, Mich	.....	No	.....	.....	10,520.00	Water department	314	50	15	.....	.....	.....	No
Holland, Mich	None	No	.....	Cr. $35.00	10,080.00	Water department	169	119	.....	.....	78	210	.....
Ishpeming, Mich	2	No	.....	.....	.....	Water department	139	.....	.....	.....	3	136	Yes
Jackson, Mich	100	No	.....	.....	.....	Water department	674	20	.....	.....	20	674	Yes
Ludington, Mich	None	No	.....	40.00	9,000.00	Water department	225	.....	.....	.....	.....	225	No
Marquette, Mich	None	No	.....	50.00	16,125.00	Water department	195	6	.....	.....	.....	201	.....
Mt. Clemens, Mich	None	No	.....	.....	.....	B of P. W.	198	18	.....	.....	.....	216	Yes
Owosso, Mich	None	No	.....	.....	.....	Water department	190	.....	.....	.....	2	188	Yes
Saginaw, Mich	Small	No	.....	.....	.....	Water department	696	251	.....	.....	167	780	Yes
Traverse City, Mich	1	No	.....	27.00	7,074.00	Water department	No	record	.....	.....	30	232	.....
Austin, Minn	None	No	.....	10.00	1,020.00	Water department	102	.....	.....	.....	.....	102	No
Duluth, Minn	5	No	.....	50.00	47,950.00	Water department	959	.....	.....	1	933	25	Yes
Minneapolis, Minn	.....	No	.....	.....	.....	Water department	.....	5,059	.....	.....	5,059	.....	No
St. Paul, Minn	100	No	.....	14.00	46,102.00	Water department	.....	3,293	.....	252	3,041	.....	Yes
Stillwater, Minn	67	Yes	½ mile	63.18	9,540.00	Water department	4	147	.....	.....	151	.....	.....
Virginia, Minn	1	No	.....	60 and 100	9,000.00	Water department	104	6	.....	.....	.....	.....	Yes
Jackson, Miss	3	No	.....	.....	.....	Water department	200	310	.....	.....	310	200	Yes
Meridian, Miss	None	No	.....	25.00	10,000.00	Water department	110	200	.....	.....	70	330	Yes
Yazoo City, Miss	None	No	.....	50.00	8,360.00	Water department	167	.....	.....	.....	.....	167	Yes
Kansas City, Mo	5	No	.....	.....	.....	Water department	.....	.....	.....	.....	6,000	.....	No
Excelsior Springs, Mo	None	No	.....	50.00	3,250.00	Water department	55	10	.....	.....	.....	65	Yes

Information relative to public fire service—continued

TOWN	PER CENT OF FIRES WHERE STEAMERS ARE USED	DO YOU HAVE SEPARATE HIGH PRESSURE SYSTEM?	IF SO, TO WHAT EXTENT?	ANNUAL REVENUE		WHO MAINTAINS HYDRANTS AND VALUES?	HYDRANT CONNECTIONS			DESCRIPTION OF FIRE HYDRANTS			DO HYDRANTS CONFORM TO THE NATIONAL STANDARD?
				Per hydrant	Total		4"	6"	8" and larger	4½" steamer connection and no 2½" hose connection	One 4½" steamer connection and one or more 2½" hose connection	One or more 2½" hose connection and no 4½" steamer connection	
Independence, Mo	None	No		$47 and $40	$5,680.00	Water company	127					127	Yes
Moberly, Mo.	None	No				Water department	93					93	
St. Joseph, Mo.	Seldom used	No		$40.00	43,240.00	Water company		1,081			648	433	No
St. Louis, Mo	100	No				Water department		11,083	20	6,600		4,503	Yes
Sedalia, Mo	None	No		30.00	6,870.00	Water company	169	60			229		No
Springfield, Mo.	75	No			15,040.00	Water company		376			319	57	
Billings, Mont.	40	No		59.55	10,125.00		71	99			75	95	Yes
Butte, Mont.	None	No		50.00	26,100.00	Water company	492	30				522	Yes
Omaha, Neb.		No				Water department		2,047			1,800	247	
Concord, N. H.	Very small	Yes	In business district			Water department	6	407	17		413	17	Yes
Dover, N. H.	Seldom	No			4,000.00	Water department		218		7		211	Yes
Keene, N. H.	Nearly all	No				Water department	268	13	1		1	281	No
Manchester, N. H.		No		25.00	23,075.00	Water department		941			941		Yes
Bridgeton, N. J.	Nearly all	No				B. of P. W	275				275		Yes
Camden, N. J.	100	No				Water department	300	597			600	297	Yes
Newark, N. J.	100	Yes	Business district			Water department	2,192	866	9				Yes
Garfield, N. J.	None	No		25.00	4,000.00	Water department	150	10			10	150	Yes
Passaic, N. J.	1	No		20–53.13	19,000.00	Water company	211	431			371	268	Yes
Paterson, N. J.	100	No		30.00	43,755.00	Water company	1,179	245	16		475	960	Yes
Perth Amboy, N. J.	20	No				Water department	105	203			168	140	Yes

Phillipsburg, N. J.	5	No		$20.00	$2,060.00	Water company							
Rahway, N. J.	Seldom	No				Water department	178	12				190	Yes
Albuquerque, N. M.	10	No		35-50	9,270.00	Water company	227				24	198	Yes
Las Vegas, N. M	None	No		20.00	1,260.00	Water company	63					63	Yes
Auburn, N. Y.	1	No		17.00	11,118.00	Water department	153	511				664	Yes
Binghamton, N. Y.	100	No				Water department		855					Yes
Buffalo, N. Y.	100	Yes	But not connected to water department	15.00	78,150.00	Water department		5,210			5,210		Yes
Canandaigua, N. Y.	None	No				Water department	34	138				172	No
Cortland, N. Y.	2	No		33.33⅓	7,266.67	Water department	211	7				218	Yes
Dunkirk, N. Y.	None	No				Water department	174	25			25	174	Yes
Elmira, N. Y.	5	No		All purposes	19,000.00	Water company	163	350			513		Yes
Geneva, N. Y.	3	No		$10.00	2,860.00	B. of P. N.	286				67	219	Yes
Glens Falls, N. Y.	None	No				Water department	272	60			202	130	No
Gloversville, N. Y.	None	No				Water department	300	46				346	No
Huntington, N. Y.	None	No		30.00	1,986.25	Water company	91	1				92	No
Jamestown, N. Y.	10	No			12,000.00	Water department					15	460	
Kingston, N. Y.	None	No				Water department	479					479	Yes
Little Falls, N. Y.	None	1 St.			3,500.00		115	35			145	5	No
Mount Vernon, N. Y.	100	No		30.00	21,240.00	Water company	708				500	207	Yes
New Rochelle, N. Y.		No		30.00	26,280.00	Water company	874	2			876		
Newburgh, N. Y.		No				Water company	414					414	Yes
North Tonawanda, N. Y.	None	No				Water department	380					380	Yes
Ogdensburg, N. Y.	25	No				Water department	80	131		1		210	No
Olean, N. Y.	None	No				Water department	275	45				320	Yes
Ossining, N. Y.	10	No				Water department	185	2				187	No
Peekskill, N. Y.	Seldom	Yes				Fire department							Yes
Rensselaer, N. Y.	None	No		40.00	7,680.00	Water company	157	35				192	Yes
Seneca Falls, N. Y.	2	No		40.00	3,400.00	Water company	43	42			85		No
Schenectady, N. Y.	25	No		Assessment	80,000.00	Water department							Yes
Troy, N. Y	100	No				Water department	1,055	20		1,000	75		No
Utica, N. Y.		No			41,046.00	Water company	643	507	31		559	622	No
Waterford, N. Y		No		$25 and $50	4,275.00	Water company	97	4			14	87	No

Information relative to public fire service—continued

TOWN	PER CENT OF FIRES WHERE STEAMERS ARE USED	DO YOU HAVE SEPARATE HIGH PRESSURE SYSTEM?	IF SO, TO WHAT EXTENT?	ANNUAL REVENUE		WHO MAINTAINS HYDRANTS AND VALUES?	HYDRANT CONNECTIONS			DESCRIPTION OF FIRE HYDRANT			DO HYDRANTS CONFORM TO THE NATIONAL STANDARD?
				Per hydrant	Total		4"	6"	8" and larger	4½" steamer connection and no 2½" hose connection	One 4½" steamer connection and one or more 2½" hose connection	One or more 2½" hose connection and no 4½" steamer connection	
Watertown, N. Y.	50	No				Water department	426						Yes
White Plains, N. Y.	None	No				Water department	352	9	27			388	Yes
Yonkers, N. Y.	None	No				Water department	1,634					1,634	No
Asheville, N. C	None	No				Water department	65	260				325	Yes
Durham, N. C.				100 free Over 100 $40.00	$4,600.00	Water company	215				215		
Elizabeth City, N. C.	.25	No		35.00	3,220.00	Water company	96				96		Yes
Wilmington, N. C.	Seldom	No				Water department					80	150	Yes
Grand Forks, N. D.	Seldom	No				Water department	53	192	7		252		Yes
Canton, Ohio		No				Water department	558		2	2		558	Yes
Cincinnati, Ohio	95	Yes	1 mile			Fire department							No
Columbus, Ohio	100	No				Fire department							
Conneaut, Ohio	None	No		35.00	6,545.00	Water company	172	15				187	Yes
Delaware, Ohio	None	No		40.00	10.520.00	Water company	263					263	Yes
Elyria, Ohio	All calls	No				Water department					358		Yes
Fremont, Ohio	None	No				Water department					220		
Marion, Ohio	80	No		$37 and $30	13,890.00	Water company	430				354	86	Yes
Massillon, Ohio	Seldom	No		$27.50 & $25	8,475.00	Water company	309					309	No
Middletown, Ohio	None	No				Water department	287					287	No
Newark, Ohio	None	No				Department of public safety	230	481			287	424	No
Piqua, Ohio	100	No				Water department	258	2			260		Yes

Springfield, Ohio	2	No				Water department		725			689	36	Yes
Warren, Ohio	None	No				Water company						179	Yes
Youngstown, Ohio	5	No				Water department							
Zanesville, Ohio	None	No				Water department					25	395	Yes
Guthrie, Okla	None	No				Water department	127	3		3		127	Yes
Muskogee, Okla	In business districts only	No				Water department		628			383	245	Yes
Oklahoma City, Okla	100	Yes	5 miles			Water department	434	332	29		54	741	Yes
Shawnee, Okla	None	No				Water department	160	18		18	160		Yes
Dallas, Ore	None	No			$720.00	City of Dallas	50					50	No
Heppner, Ore	None	No		$21 & $66.66	1,145.00	Water company	38					38	No
Portland, Ore	100	No				Fire department	4,007						
Allentown, Pa	5	No	None	None	None	Water department	537			104		433	Yes
Altoona, Pa	5	No		None	None	Water department	258	516					No
Bradford, Pa	Not used	No		None	None	Water department				282			No
Erie, Pa	50	No	None	None	None	Water department	918						No
Duquesne, Pa	Not used	No		$40.00	$4,600.00	Water department		115				115	Yes
Johnstown, Pa	100	No		25.00		Water company	111	121			80	152	Yes
McKeesport, Pa	None	No		40.00	18,880.00	Water department	466	6				472	Yes
Philadelphia, Pa	30 to 35	Yes	49 miles	None	None	Water department		16,102		840 high	pressure	hydrants	None
Lebanon, Pa	100	No		None	None	Water department	28	180				180	Yes
Meadville, Pa	None	No		None	None	Water department	100	80			4	176	Standard connection
Nazareth, Pa	None	No		$20.00	$1,140.00	Water company	51	6					Yes
New Holland, Pa													
North East, Pa	None	No				Water department	60				2		No
Reading, Pa	50	No		None	None	Water department	16	969			969	16	No
Sharon, Pa	None	No		$35.00	$8,190.00		234						Yes
Shenandoah, Pa	5	No		None	None	Fire apparatus company	102	12	None		125		Yes
Sunbury, Pa	1	No		$18.00	$1,566.00	Water company	67	20	None			87	Yes
Wilkinsburg, Pa		No		$30 to $50	35,000.00	Water company					479		No
Williamsport, Pa	Very small	No		5.00	1,780.00	City	350	6					No

Information relative to public fire service—concluded

TOWN	PER CENT OF FIRES WHERE STEAMERS ARE USED	DO YOU HAVE SEPARATE HIGH PRESSURE SYSTEM?	IF SO, TO WHAT EXTENT?	ANNUAL REVENUE		WHO MAINTAINS HYDRANTS AND VALUES?	HYDRANT CONNECTIONS			DESCRIPTION OF FIRE HYDRANT			DO HYDRANTS CONFORM TO THE NATIONAL STANDARD?
				Per hydrant	Total		4"	6"	8" and larger	4½" steamer connection and no 2½" hose connection	One 4½" steamer connection and one or more 2½" hose connection	One or more 2½" hose connection and no 4½" steamer connection	
Providence, R. I.	Very small	Yes	1¼ square miles	.....	$20,000.00	Water department	.....	.....	.....	.....	.....	2,445	.....
Charleston, S. C.	100	No	.....	$40.00	25,120.00	Water company	.....	100	None	.....	628	.....	Yes
Columbia, S. C.	7	No	.....	None	None	Water department	23	286	None	None	126	183	Yes
Mitchell, S. D.	None	No	.....	None	None	Water department	81	.....	.....	None	None	81	Yes
Clarksville, Tenn	Business district	No	.....	$50.00	$6,500.00	Water department	.....	.....	.....	.....	131	.....	Yes
Jackson, Tenn	80	.....	.....	None	None	Water department	.....	.....	.....	.....	All	.....	.....
Memphis, Tenn.	75	No	.....	None	None	Water department Paid by fire department	1,000	522	.....	.....	1,472	50	Yes
Nashville, Tenn.	100	No	.....	None	None	Water department	.....	.....	.....	.....	.....	.....	Yes
Denison, Texas	100	No	.....	None	None	Water department	125	46	None	.....	9	162	Yes
El Paso, Texas	2	No	.....	$52.50	$30,000.00	Water department	None	175	128	.....	303	.....	Yes
Galveston, Texas	Large fires	No	.....	None	None	Water department	.....	.....	.....	.....	.....	.....	Yes
Laredo, Texas	None	No	.....	$40.00	$5,400.00	Water company	135	None	None	.....	135	.....	.....
San Antonio, Texas	Partly	No	.....	.....	24,000.00	Water company	541	800	None	.....	279	1,062	Yes
Temple, Texas	None	No	.....	None	None	Water department	72	50	None	.....	50	72	Yes
Waco, Texas	90	No	.....	.....	$12,500.00	Water department	220	300	None	.....	520	.....	No
Ogden, Utah	Very small	.....	.....	$35.00	5,145.00	Water department	.....	147	.....	.....	147	.....	Yes
Salt Lake City, Utah	.....	No	.....	None	None	Water department	1,006	729	None	.....	1,735	.....	No
Burlington, Vt.	Less than 5	Yes	.....	$20.00	$4,060.00	Water department	.....	.....	.....	.....	.....	.....	Yes
Manchester, Vt.	None	.....	.....	$15 to $25	915.00	Water company	44	None	None	.....	45	.....	.....
Rutland, Vt.	None	No	.....	.....	.....	Water department	.....	.....	.....	.....	5	164	Yes

Lynchburg, Va	40	Yes		None	None	Water department	100	325	None		310	15	Yes
Richmond, Va	95	No		None	None	Water department	1,229	10			718	521	Yes
Roanoke, Va	None	No		$20.00	$5,740.00	Water company	162	130	1		133	160	Yes
Anacortes, Wash	None	No		54.00	1,728.00	Water company	3	28				31	Yes
Hoquiam, Wash	None	No		$30 to $40	3,106.21	Water company		6			110		Yes
Marcus, Wash	None	No		18.00	480.00	Water company	30				28	2	Yes
North Yakima, Wash	33⅓	No		45.00	6,525.00	City							
Seattle, Wash	Less than 5	No		12.00	66,000.00	Water department	53	4,799	256		5,480	20	Yes
Spokane, Wash	3.5	No			9,000.00	Water department	1,754	387	1				Yes
Tacoma, Wash	100	No		48.00	63,216.00	Water department	350	925	42		1,267	50	Yes
Walla Walla, Wash	None	No			6,000.00	Water department					284		Yes
Ashland, Wis	None	No			15,110.00	Water company	247					247	No
LaCrosse, Wis	Very small	No				Water department		541			541		Yes
Madison, Wis	None	No		40.00	14,760.00	Water department	360	72			72	360	Yes
Marinette, Wis	None	No		30.00	9,650.00	Water company					260		
Racine, Wis		No		25.00	16,500.00	Water company					660		
Superior, Wis	1.5			40.00	31,040.00	Water company	24	752			686	90	No
Waukesha, Wis	None	No		30.00	7,170.00	Water department		239			232	7	
Beloit, Wis	None	No		36.50	15,264.62		110	97					Yes
Green Bay, Wis	None	No			24,000.00	Water company		416			21	395	Yes
Milwaukee, Wis	100	Yes		5.00	16,700.00	Water department		3,340			3,340		Yes
Cheyenne, Wyo	None	No		None	None	Water department	140	24			24	140	Yes

Information relative to private fire service

CITY	RATE FOR SERVICE AUTOMATIC SPRINKLER CONNECTIONS	RATE FOR PRIVATE FIRE HYDRANTS	MAXIMUM SIZE CONNECTION INSTALLED FOR FIRE SERVICE	DO YOU INSTALL METERS ON PRIVATE FIRE LINES?	DO YOU RECOMMEND THE METERING OF PRIVATE FIRE SERVICE LINES?
			inches		
Anniston, Ala	10 cents per head	$40.00	6	Sometimes	Yes
Bessemer, Ala	None	50.00	6	No	No
Mobile, Ala	5 cents per head	12.50	6	Now installing detectors on all fire lines	Yes
Phoenix, Ariz	None	Metered	4	Yes	Yes
Fort Smith, Ark	12½ cents per head—1st =$2.00; 5 cents per head—2nd=$2.50	$45.00	6	Few	Not prepared to answer
Pine Bluffs, Ark	$50.00	40.00	4	No	No
Pomona, Cal	.....	$1.00 per month per plug	2½	No	No
Sacramento, Cal	No rate	No rate	None	No	Yes
San Diego, Cal	$1.00 per month	Meter rate	6	Yes	By-Passed meters
San Francisco, Cal	$1.00 per inch	$1.00 per inch	6	Only on sprinkler connections	No
Stockton, Cal	None	None	None	Yes	Yes
Colorado Springs, Col	No charge	$30.00	6	No	Yes
Denver, Col	$120.00	22.50	6	No	Yes
Bristol, Conn	No rate	20.00	6	No	No
Hartford, Conn	None	None	None	Hersey detectors in use	.....
Manchester, Conn	Free	$30.00	.....	No	.....
Meridian, Conn	No charge	No charge	6	Sometimes	Yes
New Britain, Conn	None	None	.....	No	Yes
New Haven, Conn	None	$20.00	6	No	No
New London, Conn	No charge	No charge	8	No	Yes
Stamford, Conn	No charge	$16.00	8	Yes	Yes
Wilmington, Del	.....	25.00	6	Yes	Yes
Washington, D. C	Consumer pays for installation of detector	Consumer pays for installation of detector	.....	Yes	.....
Jacksonville, Fla	$12.00	Regular rate shown by detector	6	Yes	Yes

Tampa, Fla.	No rate	No rate	Not allowed	Have none	Yes
Athens, Ga.	$50.00	$50.00	6	No	Yes
Atlanta, Ga.	No charge	No charge	8	No	No
Macon, Ga.	6 cents per head	50.00	8	No	Yes
Aurora, Ill.	No charge	No charge	8	No	Yes
Cairo, Ill.	$50.00	$30.00	.....	No	Yes
Champaign, Ill.	100.00	40.00	4	Yes	Yes
Decatur, Ill.	Free	Free	6	No	No
Dixon, Ill.	$50.00	$35.00	4	No	Yes
Elgin, Ill.	Meters	Meters	6	Yes	Yes
Freeport, Ill.	2.5 cents per head	3 cents per foot of 6 inch main $7.50 per head	6	Detector meter	Yes
Kankakee, Ill.	$40.00	$40.00	4	Yes	Yes
Lincoln, Ill.	5 cents per head	50.00	6	No	Yes
Oak Park, Ill.	Have none	Have none	.....	.....	.....
Peoria, Ill.	20 cents per head	$50.00	6	No	No
Quincy, Ill.	10 cents per head	30.00	4	Yes—detector	Yes
Rockford, Ill.	Nothing	Nothing	8	No	Yes
Springfield, Ill.	.....	.....	.....	No	Yes
Streator, Ill.	$300.00	$35.00	6	No	Yes
Anderson, Ind.	50.00	50.00	6	Yes	Yes
Brazil, Ind.	None	None	.....	Yes	Yes
Elkart, Ind.	$25.00	$50.00	6	No	No
Evansville, Ind.	No charge	No charge	6	No	Yes
Fort Wayne, Ind.	$10.00	No charge	6	Sometimes	Yes
Gary, Ind.	.....	.....	.....	Yes	Yes
Hammond, Ind.	No rate	No rate	6	No	Yes
Jeffersonville, Ind.	None	None	.....	Yes	Yes
Kokomo, Ind.	5 cents per head	$25.00	4	Yes—detector	Yes
Logansport, Ind.	None	None	.....	No	No
Marion, Ind.	No charge	No charge	6	No	Yes
Mishawaka, Ind.	No charge	No charge	No limit	No	Yes
New Castle, Ind.	Free	Free	8	No	Yes
Richmond, Ind.	Have none	Have none	6	No	Yes
South Bend, Ind.	No charge	No charge	No regulation	No	Yes

Information relative to private fire service—Continued

CITY	RATE FOR SERVICE AUTOMATIC SPRINKLER CONNECTIONS	RATE FOR PRIVATE FIRE HYDRANTS	MAXIMUM SIZE CONNECTION INSTALLED FOR FIRE SERVICE	DO YOU INSTALL METERS ON PRIVATE FIRE LINES?	DO YOU RECOMMEND THE METERING OF PRIVATE FIRE SERVICE LINES?
			inches		
Terre Haute, Ind	2 inch $5.00 3 inch 10.00 4 inch 20.00	Same	4	Yes	Yes
Vincennes, Ind	$60.00	$40.00	6	Yes	Yes
Burlington, Iowa	$24.00	24.00	6	No	Depend on local conditions
Clinton, Iowa	$50.00 minimum	50.00	4	Detectors	Yes
Council Bluffs, Iowa	None	None	6	No	No
Davenport, Iowa	No charge	$40.00	6	Yes	Yes
Des Moines, Iowa	Free	Free	6	No	Yes
Dubuque, Iowa	$50.00	$50.00	6	No	Yes
Iowa City, Iowa	Have none	Have none	.....	.....	.....
Keokuk, Iowa	$50.00 minimum	$50.00	4	Detectors	Yes
Muscatine, Iowa	Metered	No rate	6	Yes	By all means
Ottumwa, Iowa	$50.00	$15.00	6	No	In some cases
Sioux City, Iowa	No charge	No charge	6	No	Yes
Waterloo, Iowa	$25.00	.....	8	No	Yes
Atchison, Kansas	Free	Free	6	Some	Yes
Fort Scott, Kansas	$50.00	$50.00	.....	No	No
Hutchinson, Kansas	100.00	36.00	6	No	.....
Lawrence, Kansas	50.00	30.00	6	No	Yes
Parsons, Kansas	.....	.....	2½	Some	Yes
Pittsburg, Kansas	Have none	Metered	6	Yes	Yes
Wichita, Kansas	$50.00 minimum	$37.50	4	Detectors	Yes
Henderson, Ky	No charge	No charge	No limit	No	Yes
Lexington, Ky	$10.00	$50.00	No limit	Yes	Yes
Louisville, Ky	6 inch $25.00	6 inch $25.00	6	No	No
Alexandria, La	No rate	No charge	4	Yes	Yes
Baton Rouge, La	Special	.....	4	Yes	Yes
Lake Charles, La	None	$60.00	6	Some	Yes

New Orleans, La		8 inch—$ 16.00	8	Some	Yes
Baltimore, Md	$100.00	100.00	8	Yes	Yes
Hagerstown, Md	50.00	50.00	6	No	No
Arlington, Mass	None	10.00	8	No	Yes
Beverly, Mass	No charge	No charge	6	No	
Brockton, Mass	No charge	No charge	6	No	Yes
Cambridge, Mass			8	Some	
Chelsea, Mass	No charge	No charge	6	No	
Clinton, Mass	No charge	No charge	6	No	Yes
Concord, Mass	Metered	No charge	6	Yes	Yes
Everett, Mass	None	None	4	No	
Fall River, Mass	None	None	6	No	Yes
Framingham, Mass	No definite rate	No definite rate	8	No	Yes
Gardner, Mass	Not any		8	No	
Gloucester, Mass	$50.00	$25.00	6	Have one	Yes
Haverhill, Mass	No charge	No charge	6	No	Yes
Lynn, Mass			6	No	Yes
Malden, Mass	No charge	No charge	8	No	No
New Bedford, Mass	No charge	No charge	10	Few	Yes
Newburyport, Mass	No charge	No charge	8	No	Yes
Northampton, Mass	Free	Free	2	No	No
Somerville, Mass	No charge	No charge	8	Not yet	Yes
Springfield, Mass	Nothing	Nothing	6	Yes	Yes
Taunton, Mass	Free	Free		No	Yes
Waltham, Mass	Nothing	Nothing	6	Under consideration	Under consideration
Winthrop, Mass	Have none	Have none		Yes	Yes
Adrian, Mich	$50.00	$50.00	6	No	Yes
Alpena, Mich	Have none	Free	6	No	No
Ann Arbor, Mich	$75.00			No	Yes
Battle Creek, Mich	25.00	$200.00	8		
Bay City, Mich	No charge	No charge	No restriction	No	Yes
Detroit, Mich	No charge	No charge	8	Yes	Yes
Escanaba, Mich	$50.00	$38.00	6	No	No
Flint City, Mich	Have none	50.00	8	No	Yes
Holland, Mich	Free	Free	6	Few	Yes
Ishpeming, Mich				No	No

Information relative to private fire service—Continued

CITY	RATE FOR SERVICE AUTOMATIC SPRINKLER CONNECTIONS	RATE FOR PRIVATE FIRE HYDRANTS	MAXIMUM SIZE CONNECTION INSTALLED FOR FIRE SERVICE	DO YOU INSTALL METERS ON PRIVATE FIRE LINES?	DO YOU RECOMMEND THE METERING OF PRIVATE FIRE SERVICE LINES?
			inches		
Jackson, Mich.	None	None	6	No	Yes
Ludington, Mich.	No charge	$50.00	6	Yes	Yes
Marquette, Mich.	Have none	Have none	.....	No	Yes
Owosso, Mich.	Nothing	Nothing	6	Yes	Yes
Saginaw, Mich.	None	None	8	No	Yes
Traverse City, Mich.	No charge	None	6	No	Yes
Duluth, Minn.	.....	.....	6	Under advisement	Yes
Minneapolis, Minn.	$5.00	$5.00	6	.....	.....
St. Paul, Minn.	25.00	18.00	12	Yes	Yes
Stillwater, Minn.	100.00	None	6	No	No
Virginia, Minn.	Have none	$100.00	.....	No	No
Jackson, Miss.	Free	Free	6	Few	Sometimes
Meridian, Miss.	15 cents per head, minimum $15.00	$10.00 to $50.00	6	Yes	Yes
Independence, Mo.	40.00	$40.00	6	No	Yes
Kansas City, Mo.	None	None	6	No	Yes
Moberley, Mo.	None	None	.....	None	Yes
St. Joseph, Mo.	No charge	$40.00	4	No	Yes
St. Louis, Mo.	No charge	No charge	6	Few	No
Sedalia, Mo.	¼ cent per head	$30.00	6	No	Depend
Springfield, Mo.	$50.00	50.00	6	Yes	Yes
Billings, Mont.	None	30.00	6	No	Yes
Butte, Mont.	No charge	$10.00 per month	2½	No	No
Missoula, Mont.	None	$60.00	6	No	No
Omaha, Neb.	$24.00	$60.00	6	No	No
Concord, N. H.	Nothing	Nothing	10	No	Yes
Dover, N. H.	None	Metered	12	No	Yes
Keene, N. H.	No charge	No charge	8	No	Yes
Manchester, N. H.	No charge	$25.00	6	No	Yes
Bridgeton, N. J.	$5.00 per year	No charge	Any size	No	No

Camden, N. J.	Metered	No charge	6	Yes	Yes
Garfield, N. J.	$75.00	$30.00	6	No	Yes
Newark, N. J.	15.00	15.00	6	Partly	Yes
Passaic, N. J.	2 inch—$ 50.00 8 inch— 400.00	Free	8	No	Yes
Paterson, N. J.	2 inch—$ 50.00 8 inch— 400.00	.....	.....	.....	.....
Perth Amboy, N. J.	Metered	.....	6	Yes	Yes
Phillipsburg, N. J.	No rate	$25.00	8	Yes	Yes
Rahway, N. J.	No charge	No charge	6	Yes	Yes
W. Orange, N. J.	Metered	Metered	6	Yes	Yes
Albuquerque, N. M.	No rate fixed	No rate fixed	6	No	Yes
Las Vegas, N. M.	Free	Free	6	No	No
Auburn, N. Y.	Free	Free	12	Yes	Yes
Binghamton, N. Y.	No charge	No charge	4	No	Yes
Cortland, N. Y.	.....	$33.33	8	Yes	Yes
Dunkirk, N. Y.	Free	Free	6	Yes, some	Yes
Elmira, N. Y.	2 inch—$25.00 6 inch— 75.00	Same	6	No	Yes
Geneva, N. Y.	No rate	No rate	8	No	No
Glens Falls, N. Y.	None	None	6	Yes	Yes
Gloversville, N. J.	No charge	No charge	6	No	Yes
Jamestown, N. Y.	No charge	$40.00	6	Yes	Yes
Kingston, N. Y.	$25.00	25.00	6	No	No
Little Falls, N. Y.	No charge	No charge	6	No	Yes
Mt. Vernon, N. Y.	Minimum $100.00 $20.00 per head	$30.00	6	No	Yes
New Rochelle, N. Y.	$30.00 per floor.....	$33.000	8	No	.....
N. Tonawanda, N. Y.	No rate	No rate	4 to 10	Yes	Yes
Ogdensburg, N. Y.	$10.00	Nothing	6	Yes	Yes
Olean, N. Y.	Metered	Regular rate	6	Yes	Yes
Ossining, N. Y.	No charge	No charge	4	No	Yes
Rensselaer, N. Y.	$100.00	.....	6	Yes	Yes
Schenectady, N. Y.	No charge	No charge	8	No	No
Syracuse, N. Y.	.....	.....	.....	.....	.....
Troy, N. Y.	No charge	No charge	No regulation	No	Yes

Information relative to private fire service—Continued

CITY	RATE FOR SERVICE AUTOMATIC SPRINKLER CONNECTIONS	RATE FOR PRIVATE FIRE HYDRANTS	MAXIMUM SIZE CONNECTION INSTALLED FOR FIRE SERVICE	DO YOU INSTALL METERS ON PRIVATE FIRE LINES?	DO YOU RECOMMEND THE METERING OF PRIVATE FIRE SERVICE LINES?
			inches		
Utica, N. Y.	$15.00 minimum	.....	8	Some	Yes
Waterford, N. Y.	12½ to 16⅔ cents per head	$50.00	6	Yes	Yes
Watertown, N. Y.	Free	Free	6	Some	Yes
White Plains, N. Y.	$50.00	$35.00	4	Not yet	Yes
Yonkers, N. Y.	No charge	No charge	8	No	Yes
Asheville, N. C.	No rate	No rate	Any size	Yes	Yes
Durham, N. C.	.....	$40.00	10	No	No
Wilmington, N. C.	None	64.00	6	No	No
Grand Forks, N. D.	No charge	No charge	6	No	No
Canton, Ohio	No rate	None	4	Yes	Yes
Cincinnati, Ohio	No charge	No charge	6	No	No
Columbus, Ohio	$6.00 per floor	$6.00	6	Few	Yes
Elyria, Ohio	Have none	Have none	8	No	Yes
Fremont, Ohio	Make no charge	Make no charge	6	No	Yes
Marion, Ohio	$8.00 minimum	$8.75 each	6	No	Yes
Massillon, Ohio	$30.00 minimum	$25.00 each	6	No	Yes
Middletown, Ohio	No charge	No charge	6	Only on stand pipe	Yes
Newark, Ohio	Have none	Have none	6	No	Yes
Piqua, Ohio	No charge	No charge	6	No	Yes
Springfield, Ohio	No charge	No charge	8	No	Yes
Tiffin, Ohio	$10.00 minimum	$30.00	.....	.....	.....
Warren, Ohio	$20.00 minimum	25.00	2½ hose	No	Yes
Youngstown, Ohio	No charge	No charge	8	Yes	Yes
Zanesville, Ohio	No charge	No charge	6	No	No
Guthrie, Okla.	Have none	Have none	.....	No	Under consideration
Muskogee, Okla.	No rate	No rate	4	No	.....
Oklahoma, Okla.	No rate	No rate	6	No	Yes
Shawnee, Okla.	None	None	6	No	Yes
Portland, Ore.	$12.00 to $60.00	$12.00 to $60.00	8	No	No

Allentown, Pa	None	None	8	No	Yes
Altoona, Pa	No charge	No charge	6	Yes	Yes
Bradford, Pa	None	None	4	No	Yes
Duquesne, Pa	Have no private service	No private service		No	No
Erie, Pa	No charge	No charge	6	No	Yes
Johnstown, Pa	$10.00 per floor	$37.50	6	No	Yes
Lebanon, Pa	No charge	No charge	4	No	Yes
McKeesport, Pa				No	
Meadville, Pa	No charge	No charge	6	No	Yes
Philadelphia, Pa	No charge	No charge	6	Yes	Yes
Reading, Pa	Free	Free	8	Yes	Yes
Sharon, Pa					
Shenandoah, Pa	None	None		No	No
Sunbury, Pa	No charge	$1.00 per opening		No	Yes
Williamsport, Pa	$75.00 to $100.00	$50.00	4	Y s	Yes
Pawtucket, R. I					
Providence, R. I			10	Yes	Yes
Charleston, S. C		$40.00	6	No	Yes
Columbia, S. C	4 inch—$ 80.00 6 inch— 160.00	10.00	8	No	No
Jackson, Tenn	No charge	No charge	6	No	Yes
Memphis, Tenn	$36.00 minimum	$24.00 minimum	6	Yes	Yes
Nashville, Tenn	8.00 minimum	Metered	4	No	Yes
Denison, Texas	Meters	No charge	3	No	Yes
El Paso, Texas	$25.00 per month	$26.25	8	No	Yes
Galveston, Texas			6	No	Yes
Laredo, Texas	None	$10.00 per annum	2	No	Can't advise
San Antonio, Texas	$25.00	$25.00	6	No	Yes
Temple, Texas	Metered	No charge	6	No	See Answer
Waco, Texas	Free	Free	6	No	Yes
Ogden, Utah	$35.00	$35.00	6	No	
Salt Lake City, Utah	Free	Free	6	Yes	Yes
Burlington, Vt	No charge	No charge	6	No	Yes
Rutland, Vt	Have none	Have none		No	
Lynchburg, Va	No charge	No charge	6	No	Yes

Information relative to private fire service—Continued

CITY	RATE FOR SERVICE AUTOMATIC SPRINKLER CONNECTIONS	RATE FOR PRIVATE FIRE HYDRANTS	MAXIMUM SIZE CONNECTION INSTALLED FOR FIRE SERVICE	DO YOU INSTALL METERS ON PRIVATE FIRE LINES?	DO YOU RECOMMEND THE METERING OF PRIVATE FIRE SERVICE LINES?
			inches		
Richmond, Va	Meter rates	Meter rates	6	Yes	Yes
Roanoke, Va	$20.00 per annum	.....	8	No	Yes
N. Yakima, Wash	No rate	No rate	Have none	None	.....
Seattle, Wash	No charge	No charge	6	Yes	Yes
Spokane, Wash	6 inch—$30.00	None	8	No	No
Tacoma, Wash	6 inch— 30.00	No charge	6	Yes	Yes
Walla Walla, Wash	No charge	No charge	.....	Yes	Yes
Ashland, Wis	$3.00 each 1,000 feet	$50.00	6	Yes	Yes
Beloit, Wis	.....	.....	6	Yes	Yes
Greenbay, Wis	6 inch—$75.00	.....	6	No	.....
La Crosse, Wis	No rate	No rate	.....	.....	Yes
Madison, Wis	4 inch—$20.00	.....	.....	No	Yes
Marinetta, Wis	$50.00 minimum	$30.00	4	Yes	Yes
Milwaukee, Wis	No charge	No charge	6	No	Yes
Racine, Wis	$50.00 minimum	$25.00	4	Yes	Yes
Superior, Wis	$40.00	40.00	Not fixed	Yes	Yes
Cheyenne, Wyo	No charge	Cost of installing $3.00 to $5.00	4	No	No
Hollister, Cal	None	.....	4	No	No
National City, Cal	No rate	Agreed amount	Agreed on	No	.....
Reedley, Cal	Have none	Have none	Have none	No	.....
Daytona, Fla	Have none	Cost of installing	4	No	No
Miami, Fla	$25.00	Have none	6	No	Yes
Downey, Idaho	Have none	$60.00	4	No	.....
Lake Forest, Ill	Metered	Metered	.....	.....	.....
Valparaiso, Ind	Have none	Have none	Have none	.....	.....
Washington, Ind	Have none	Have none	Have none	.....	Yes
Creston, Iowa	Have none	Have none	Have none	.....	Yes
Danville, Ky	Have none	Have none	Have none	.....	.....
Brunswick, Me	.....	.....	8	No	Possibly

Reading, Mass	No charge	No charge	8	No	Yes
Coldwater, Mich	No charge	No charge	4	No	No
Mt. Clemens, Mich	None	No charge	4	No	Yes
Austin, Minn	None	No charge	.....	No	.....
Yazoo City, Miss	$10.00	$5.00 to $35.00	4	No	Yes
Excelsior Spring, Mo	No charge	No charge	.....	No	No
Canandaigua, N. Y	No flat rate	Meter	6	Yes	Yes
Huntington, N. Y	None	$30.00	No regulation	No	Yes
Norwich, N. Y	No rate	No rate	No regulation	No	.....
Seneca Falls, N. Y	5 cents per head	$20.00	8	No	Yes
Elizabeth City, N. C	None	30.00	6	No	No
Conneaut, Ohio	$50.00	Metered	12	Yes	Yes
Delaware, Ohio	No rate	$40.00	6	No	Yes
Nazareth, Pa	Only one	20.00	6	No	.....
New Holland, Pa	Metered	Metered	2	.....	.....
North East, Pa	No charge	No charge	6	No	.....
Mitchell, S. D	Have none	Have none	.....	No	Yes
Clarksville, Tenn	4 inch—$50.00	No charge	6	Yes	Yes
Manchester, Vt	None	$25.00	4	No	.....
Anacortes, Wash	Metered	Metered	.....	.....	.....
Hoquiam, Wash	$6.00 to $75.00	.....	8	Yes	Yes
Waukesha, Wis	.....	$30.00	6	Yes	.....
Newport, Ky	No charge	15.00	6	No	No

Information relative to private service lines

CITY	INSTALLED BY WHOM	PAID BY	PRICE PER FOOT	BY WHOM MAINTAINED	DO YOU CHARGE FOR TAP?	IF SO, PRICE FOR SAME	SIZE OF TAP FOR ORDINARY RESIDENCE
Anniston, Ala.	Licensed plumbers	.....	.....	Water company to curb	Yes	$8.00 to $50.00 owing to size	1" tap with ¾" pipe
Anniston, Ala.	Licensed plumbers	Consumer	12½ $0.40	Consumer	No	.....	¾" tap
Mobile, Ala.	Water department	Water department	.....	Water department	No	.....	¾" tap
Phoenix, Ariz.	Water department	See charge for taps	.....	Water department	Yes	¾" $7.00 1" 9.00 1½" 15.00 2" 25.00	¾" x 1" for ordinary residence
Fort Smith, Ariz.	Licensed plumbers	Consumer	.....	Consumer	Yes	½" 2.75 ¾" 3.25 ¾" 4.00 1" 5.00	½" x ¾"
Pine Bluff, Ariz.	Water company	Water company	Free	Water company	No	.....	¾"
Pomona, Cal.	Water company	Water company	.....	Water company	.....	$15.00 charge for ¾" tap	¾" pipe to curb including setting of ¾" meter
Sacramento, Cal.	Licensed plumbers	Consumer	.....	Consumer	Yes	¾" $5.00 1" 7.50	¾" x 1"
San Diego, Cal.	Water department	Consumer	¾" $10.00 1" 12.00	Water department	Yes	See price for service lines	¾"
San Francisco, Cal.	Water company	Consumer	.....	Water company	Yes	¾" $10.00-15.00 1" $25.00 2" 30.00 including service	¾" tap
Stockton, Cal	Water company	Consumer	$8.00	Water company	Yes	$8.00	¾"
Colorado Springs, Col.	Licensed plumbers	Consumer	.20	Consumer	Yes	½" $6.60 ¾" 7.60 ¾" 9.35	¾"
Denver, Col.	Licensed plumbers	Consumer	.40	Consumer	Yes	½" 3.00 ¾" 4.00 ¾" 5.00	¾"

Denver, Col.	Licensed plumbers	Consumer	$0.40	Consumer	Yes	1″ $6.00 1½″ 10.00 1½″ 12.50 2″ 15.00	½″
Bristol, Conn.	Licensed plumbers	Consumer		Consumer	No		½″
Hartford, Conn.	Water department and plumbers			Water company and owner			¾″ x 1″
Manchester, Conn.	Water company	Water company			No		¾″
Meriden, Conn.	Water department and owner	Jointly		Jointly	No		¾″ x ¾″
New Britain, Conn.	Licensed plumbers	Consumer		Owner	No		¾″
New Haven, Conn.	Plumbers	Consumer		Owner	Yes	½″ $4.00 ¾″ 5.00 1″ 6.00	½″
New London, Conn.	Water company	Water company	$0.55	Water company	No		½″
Stamford, Conn.	Licensed plumbers	Consumer		Consumer	Yes	½″ Comp $6.00 ¾″ 9.00	½″
Wilmington, Del.	Water department and plumbers	Jointly	0.88½	Jointly	No		¾″ x ¾″
Washington, D. C.	Licensed plumbers	Consumer		Consumer	Yes	¾″ x 1″ $3.00 1½″ 4.00 1½″ 5.00 2″ 8.00	¾″
Jacksonville, Fla.	Water department	Consumer		Consumer	Yes	¾″ tap x ¾″ meter on improved street $16.00 ¾″ tap x 1″ meter on improved street $23.00	¾″ tap x ¾″ service pipe
Miami, Fla.	Water company	Company		Company	No		¾″
Athens, Ga.	Licensed plumbers	Consumer	$0.10	Consumer	No		¾″
Atlanta, Ga.	Water department	Owner		Water department	Yes	¾″ service x ¾″ meter, $25.00	¾″ service ¾″ meter
Macon, Ga.	Licensed plumbers	Owner		Owner	Yes	¾ x ¾″ $2.50 1″ 4.00 1½″ 15.00	¾″ x ¾″
Downey, Idaho	Water company	Owner	Cost	Owner	Yes	Cost	¾″

Information relative to private service lines—Continued

CITY	INSTALLED BY WHOM	PAID BY	PRICE PER FOOT	BY WHOM MAINTAINED	DO YOU CHARGE FOR TAP?	IF SO, PRICE FOR SAME	SIZE OF TAP FOR ORDINARY RESIDENCE
Aurora, Ill	Licensed plumbers	Owner	Cost	Owner	Yes	¾", 1", 1", $2.50	¾" x ¾"
Champaign, Ill	Water company	Owner	.....	Water company	Yes	¾" $10.00, including service	¾"
Decatur, Ill	Licensed plumbers	Owner	.....	Owner	No	.....	¾"
Elgin, Ill	Water department	Water department	.....	Water department	Yes	¾" $11.50 1" 13.50 1¼" 17.50 including service	¾" x ¾"
Dixon, Ill	Licensed plumbers	Owner	.....	Owner	Yes	$1.90 all sizes	¾"
Freeport, Ill	Water company	Owner	Cost	Water company	Yes	Cost	¾"
Kankakee, Ill	Water company	Owner	$5.00	Water company	Yes	Included in service charge	¾"
Lake Forest, Ill	Plumbers or company	Owner	.....	Owner	Yes	¾" $5.50 1" 7.50 1½" 15.00 2" 20.00	¾"
Lincoln, Ill	Water company	Owner	.....	Owner	.....	¾" tap x ¾" service Improved street $12.00 Graded street $6.00	¾"
Oak Park, Ill	Licensed plumbers	Owner	$15.00	Owner	Yes	¾" x ¾" $3.00 1" 3.50	¾"
Peoria, Ill	Company and plumbers	Jointly	.....	Jointly	No	.....	¾" x ¾"
Quincy, Ill	Company and plumbers	Owner	$0.55 .68	Jointly	Yes	Included in service charge	¾" x ¾"
Rockford, Ill	Water department	Owner	16.00 21.00	Water department	Yes	Included in service charge	¾"
Springfield, Ill	Plumbers and company	Owner	10.00	Owner	.....	¾" lead service $10.00 for 30' or less	¾"

Springfield, Ill	Plumbers and company	Owner	$10.00	Owner	.....	Galv. pipe $10.00 for 75 feet or less	¾"
Streator, Ill	Licensed plumbers	Owner	.....	Owner	No	.....	¾" x ¾"
Anderson, Ind	Water department	Owner	.....	Water department	Yes	¾" x ¾" $7.00 1" 10.00 1¼" 15.00 $3.00 extra for brick street	¾"
Brazil, Ind	Water department	Owner	$7.50 12.00	Jointly	Yes	Included in service charge	¾"
Elkhart, Ind	Licensed plumbers	Owner	.....	Owner	Yes	¾" $2.00	¾"
Evansville, Ind	Water department	Owner	$0.43½ .53½ 1.00 1.66⅔	Water department	Yes	$6.50 dirt 8.00 gravel 15.00 brick 25.00 asphalt	¾"
Fort Wayne, Ind	Company and plumbers	Owner	Cost	Jointly	No	.....	¾"
Hammond, Ind	.....	Owner	$0.55	Owner	Yes	$2.00 each all sizes	¾"
Indianapolis, Ind	Licensed plumbers	Owner	.....	Owner	No	.....	¾"
Jeffersonville, Ind	Company and plumbers	.....	.....	Water company	No	.....	¾"
Kokomo, Ind	Water company	Company	.....	Company	No	.....	¾"
Logansport, Ind	Water department	.....	.....	Water department	Yes	$5.00 per tap	¾"
Marion, Ind	Licensed plumber	Owner	.....	Jointly	No	.....	¾"
Mishawaka, Ind	Water department and plumbers	Owner	.....	Water department	Yes	¾" $14.00 ¾" 15.00 1" 17.00 including service to property line	¾"
New Castle, Ind	Water department	Owner	.....	Water department	Yes	¾" or less $7.50 1" $10.00 1¼" 15.00 2" 20.00	¾"
Richmond, Ind	Water company	Owner	$10.00	Owner	Yes	Included in service charge	¾"
South Bend, Ind	Licensed plumbers	Owner	.....	Owner	Yes	¾" $4.00 1" 6.00	¾"

Information relative to private service lines—Continued

CITY	INSTALLED BY WHOM	PAID BY	PRICE PER FOOT	BY WHOM MAINTAINED	DO YOU CHARGE FOR TAP?	IF SO, PRICE FOR SAME	SIZE OF TAP FOR ORDINARY RESIDENCE
Terre Haute, Ind.	Water company and plumbers	Owner to curb	$8.00	Owner	No	.....	¾″
Vincennes, Ind.	Water company	Company	.....	Company	Yes	Cost	¾″ x ¾″
Valparaiso, Ind.	Licensed plumbers	Owner	.....	Company	Yes	¾″ $9.00 1″ 10.00 1¼″ 12.00 1½″ 15.00	¾″
Washington, Ind.	Water company	Company	$0.35	Company	No	.....	¾″
Burlington, Iowa.	Company and plumbers	Owner to plumber	.25	Jointly	No	.....	¾″
Clinton, Iowa.	Water company	Consumer	.....	Consumer	.....	.....	¾″
Council Bluffs, Iowa.	Plumbers	Owner	$0.75	Owner	Yes	¾″ x less $2.50 1″ 3.00	¾″ x ¾″
Creston, Iowa.	Licensed plumbers	Owner	.20 .35	Owner	Tapping by plumber		¾″
Davenport, Iowa.	Plumbers	Owner	.....	Owner	No	.....	¾″ x ¾″
Des Moines, Iowa.	Plumbers	Owner	.....	Owner	No	.....	¾″
Iowa City, Iowa.	Licensed plumbers	Owner	$0.60	Owner	Yes	$1.00 for all sizes	¾″ x ¾″
Keokuk, Iowa.	Plumbers	Owner	.....	Owner	Yes	1.00 for all sizes	¾″
Muscatine, Iowa.	Licensed plumbers	Owner	.....	Owner	Yes	Cost	¾″
Ottumwa, Iowa.	Licensed plumbers	Owner	$0.35	Owner	No	.....	¾″
Sioux City, Iowa.	Licensed plumbers	Owner	.....	Owner	Yes	¾″ $3.00 1″ 4.00 1¼″ 5.00 1½″ 7.00	¾″
Waterloo, Iowa.	Licensed plumbers	Owner	.....	Owner	Yes	1″ or less 1.00	¾″
Atchison, Kan.	Licensed plumbers	Owner	$0.22	Owner	Yes	¾″ x less 2.00	¾″
Fort Scott, Kan.	Plumbers	Owner	.125	Owner	Yes	¾″ 4.00	¾″
Hutchinson, Kan.	Plumbers	Owner	.....	Company	No	.....	¾″
Lawrence, Kan.	Plumbers	Owner	.....	Owner	Yes	¾″ $4.00 1″ 6.00 1½″ 7.50	¾″

Parsons, Kan.	Licensed plumbers	Owner	$0.15 .35	Owner	Yes	½" $2.00 ¾" 2.25 1" 3.00	½"
Pittsburg, Kan.	Licensed plumbers	Owner	.12 .75	Owner	Yes	¾ x ½" 1.00	½"
Wichita, Kan.	Plumbers	Owner		Owner	Yes	½" 2.00 ¾" 3.00 1" 4.00	½"
Danville, Ky.	Licensed plumbers	Owner		Jointly	No		½"
Henderson, Ky.	Water department	Owner		Water department	Yes	¾" $8.00 1" 10.00 including service	½"
Lexington, Ky.	Water company	Owner		Company	Yes	½" $14.50 including service	½"
Louisville, Ky.	Water department	Owner		Water department	Yes	½" $11.14 including service	½"
Newport, Ky.	Water department	Owner	½" $0.80 ¾" .95	Water department	Yes		½"
Alexandria, La.	Water department and plumbers	Owner		Water department	Yes	½" $6.00 ¾" 9.00 1" 12.00 including service	½"
Baton Rouge, La.	Licensed plumbers	Owner		Owner	Yes	$2.50 for all sizes	½" to 1"
Lake Charles, La.	Licensed plumbers	Owner		Owner	Yes	$1.00	¾"
New Orleans, La.	Water department	Department		Department	No		¾"
Brunswick, Me.	Water department	Owner	Cost	Owner	No		¾"
Baltimore County, Md.	Water department	Owner	$9.00 12.00	Owner	Yes	1" $13.50	¾"
Cumberland, Md.	Water department	Water department			No		¾"
Hagerstown, Md.	Water company	Owner	$0.20	Water company	Yes	$5.00	¾"
Arlington, Mass.	Water department	Owner		Owner	No		¾" x ¾"
Beverly, Mass.	Water department	Water department		Water department	No		¾"
Boston, Mass.							
Brockton, Mass.	Water department	Jointly		Jointly	No		¾"
Brookline, Mass.	Water department	Owner	$0.33	Jointly	No		¾"
Cambridge, Mass.	Water department	Owner	Cost	Jointly	Yes	Average cost $3.17 including service	¾"

Information relative to private service lines—Continued

CITY	INSTALLED BY WHOM	PAID BY	PRICE PER FOOT	BY WHOM MAINTAINED	DO YOU CHARGE FOR TAP	IF SO, PRICE FOR SAME	SIZE OF TAP FOR ORDINARY RESIDENCE
Chelsea, Mass	Water department	Water department		Water department	No		¾″
Clinton, Mass	Water department	Jointly	$0.30	Jointly	No		¾″
Concord, Mass	Water department	Jointly	Cost and 10 per cent	Jointly	No		1″ x ¾″
Everett, Mass	Water department	Owner	$0.40	Water department	No		¾″
Fall River, Mass	Water department and plumbers	Jointly		Jointly	No		¾″ to 1″
Framingham, Mass	Water department	Jointly		Jointly			¾″
Gardner, Mass	Water department	Jointly	$0.30	Jointly			¾″
Gloucester, Mass	Water department	Jointly	.45	Jointly	No		¾″
Haverhill, Mass	Water department	Owner	.40 .50	Owner	Yes	$2.00 all sizes	¾″
Lowell, Mass	Water department				No		¾″
Lynn, Mass	Water department	Jointly		Water department	No		¾″ x 1″
Malden, Mass	Water department	Jointly		Jointly	No		¾″
New Bedford, Mass	Water department	Jointly		Jointly	Yes	$2.00 all sizes	¾″, ¾″, ¾″, 1″, depending upon district
Newburyport, Mass	Water department	Jointly	$0.35	Jointly	No		¾″
Northampton, Mass	Water department	Jointly		Jointly	Yes	$3.00	¾″ x 1″
Reading, Mass	Water department	Jointly	$0.40	Jointly	No		¾″
Somerville, Mass	Water department	Owner		Jointly	Yes	¾″ $17.00 1″ 25.00 including service	¾″
Springfield Mass	Water department	Owner		Owner	Yes	Cost only	1″
Taunton, Mass	Water department	Jointly	$0.35	Water department	No		1″
Waltham, Mass	Water department	Jointly	.40	Water department	No		1″
Winthrop, Mass	Water department	Jointly	.38 .60	Jointly	Yes	Included in service charge	¾″ x ¾″
Adrian, Mich	Water company	Jointly	.25	Owner	Yes	¾″ $5.00 1″ 10.00 including service to curb	¾″

Alpena, Mich.	Licensed plumbers	Owner		Owner	Yes	¾″ $2.50 1″ 3.00 1¼″ 3.50	¾″
Ann Arbor, Mich.	Water company			Water company	Yes	$10.00	¾″
Battle Creek, Mich.	Water department and licensed plumbers	Jointly	$0.18 .45		No		¾″
Bay City, Mich	Water department and licensed plumbers	Owner		Owner	Yes		¾″
Coldwater, Mich.	Water department			Jointly	Yes	$5.00 for ¾″	¾″
Detroit, Mich	Licensed plumbers	Owner		Owner	Yes	¾″ $2.25 1″ 3.25	¾″
Escanaba, Mich.	Water company	Owner		Owner	Yes	$15.00 for ¾″ including service	¾″ x 1″
Flint, Mich	Licensed plumbers	Owner		Owner	Yes	$1.50	¾″
Holland, Mich.	Licensed plumbers	Owner		Owner	Yes	¾″ $3.00 1″ 4.00 1¼″ 6.00	¾″
Ishpeming, Mich.	Water department and plumbers	Jointly		Water department	Yes	$12.00 including service to curb	¾″
Jackson, Mich.	Licensed plumbers	Owner		Owner	Yes	¾″ $3.00 1″ 3.50	¾″
Ludington, Mich.	Licensed plumbers	Owner		Owner	Yes	¾″ 2.25 1″ 10.00	¾″
Marquette, Mich	Water department	Owner		Owner	Yes	¾″ 8.00 1″ 12.00 1¼″ 16.00 service included	¾″
Mt. Clemens, Mich.	Licensed plumbers	Owner		Owner	Yes	¾″ $9.00 1″ 10.00 service to stop included	¾″
Owosso, Mich.	Water department	Owner		Jointly	Yes	$10.00 including service to curb	¾″
Saginaw, Mich.	Water department and licensed plumbers	Owner		Jointly	Yes	¾″ $15.50, service to curb included	¾″

Information relative to private service lines—Continued

CITY	INSTALLED BY WHOM	PAID BY	PRICE PER FOOT	BY WHOM MAINTAINED	DO YOU CHARGE FOR TAP	IF SO, PRICE FOR SAME	SIZE OF TAP FOR ORDINARY RESIDENCE
Traverse City, Mich.	Water department and plumbers	Owner	.....	Jointly	Yes	$5.00 service to curb included	¾"
Austin, Minn.	Licensed plumbers	Owner	.....	Owner	Yes	¾" $2.50 1" 3.00 1" 5.00	¾"
Duluth, Minn.	Water department and plumbers	Owner	0.90	Owner	Yes	Included in service charge	¾"
Minneapolis, Minn.	Licensed plumbers	Owner	.....	Owner	.....	.....	¾"
St. Paul, Minn.	Water department	Owner	.....	Jointly	.....	.....	¾"
Stillwater, Minn.	Water department	Owner	0.30 1.50	Owner	Yes	¾" $3.00 1" 3.50 1" 4.50	¾"
Virginia, Minn.	Plumbers	Owner	.....	Owner	No	.....	¾"
Jackson, Miss.	Water department	Owner	.....	Owner	Yes	¾" $10.00 1" 12.00 Service included	¾"
Meridian, Miss.	Department and plumbers	Owner	0.08 0.12	Water department	Yes	¾" $4.00 1" 5.00 Meter box included	¾"
Yazoo City, Miss.	Water department and plumbers	Owner	0.10	Jointly	Yes	¾" $7.50 1" 8.50 1" 10.00 including service to curb	¾"
Kansas City, Mo.	Licensed plumbers	Owner	.....	Owner	Yes	¾" $2.00 1" 3.00 1" 4.00	¾"
Excelsior Springs, Mo.	Plumbers	Owner	.....	Jointly	Yes	$6.00 including service to curb	¾"
Independence, Mo.	Licensed plumbers	Owner	0.25	Owner	Yes	¾" $2.50 1" 2.90 1" 4.00	1"

Moberly, Mo.	Licensed plumbers	Owner	0.25 0.40	Owner	Yes	¾″ 3.00 1″ 4.00 1′ 5.00	1″
St. Joseph, Mo.	Plumbers	Owner	.....	Owner	Yes	¾″ 2.50 1″ 2.75 1¼″ 4.25	¾″ x ½″
St. Louis, Mo.	Department and plumbers	Owner	.....	Owner	Yes	½″ 3.00 ¾″ 3.15 1″ 3.65	¾″
Sedalia, Mo.	Licensed plumbers	Owner	.....	Owner	Yes	½″ 2.75 ¾″ 4.00	½″
Springfield, Mo.	Water company	Owner	.....	Owner	Yes	¾″ 4.00	¾″
Billings, Mont.	Licensed plumbers	Owner	0.35	Owner	Yes	½″ 5.00 ¾″ 7.00 1′ 9.00	½″
Butte, Mont.	Licensed plumbers	Owner	.....	Owner	Yes	¾″ 6.50 1″ 9.00 including stop and box	¾″
Omaha, Neb.	Licensed plumbers	Owner	.....	Owner	Yes	¾″ $2.00 ½″ 2.75 ¾″ 3.25 1″ 4.00	¾″ x ½″
Concord, N. H.	Water department and licensed plumbers	Jointly	.....	Jointly	No	.....	½″
Dover, N. H.	Water department	Owner	0.29	Jointly	No	.....	¾″
Keene, N. H.	Water department	Owner	.....	Jointly	Yes	¾″ $9.00 including service	¾″
Manchester, N. H.	Water department	Jointly	0.00	Jointly	No	.....	1″
Bridgeton, N. J.	Any one	Owner	.....	Owner	Yes	$2.00	¾″
Camden, N. J.	Licensed plumbers	Owner	.....	Owner	Yes	¾″ $3.50 1″ 4.50 1¼″ 5.50 1′ 6.50	½″
Newark, N. J.	Water department	Owner	.....	Owner	Yes	¾″ 14.00 1″ 20.00	¾″

Information relative to private service lines—Continued

CITY	INSTALLED BY WHOM	PAID BY	PRICE PER FOOT	BY WHOM MAINTAINED	DO YOU CHARGE FOR TAP	IF SO, PRICE FOR SAME	SIZE OF TAP FOR ORDINARY RESIDENCE
Garfield, N J.	Licensed plumbers	Owner	.....	Owner	Yes	$4.00	¾″
Passaic, N. J.	Water company	Owner	0.30	Jointly	Yes	$16.50 including service to curb	¾″
Paterson, N. J.	Water company	Owner	0.30	Jointly	Yes	$14.00 including service to curb	¾″
Perth Amboy, N. J.	Plumbers	Owner	.....	Owner	Yes	¾″ $2.50 ¾″ 3.00 1″ 4.00	1″
Phillipsburg, N. J.	Plumbers	Owner	.....	Owner	No	.....	¾″
Rahway, N. J.	Licensed plumbers	Owner	.....	Owner	Yes	¾″ $2.75 ¾″ 3.25 1″ 3.75	¾″
Albuquerque, N. M.	Licensed plumbers	Owner	.....	Owner	Yes	¾″ 5.00 1″ 7.50 1¼″ 10.00	¾″
Las Vegas, N. M.	Licensed plumbers	Owner	.....	Owner	No	.....	¾″
Auburn, N. Y.	Water department	Owner	.....	Owner	Yes	Cost	¾″
Binghamton, N. Y.	Water department	Owner	.....	Water department	Yes	¾″ $9.00 ¾″ 10.00	¾″
Buffalo, N. Y.	Licensed plumbers	Owner	.....	Owner	Yes	¾″ 2.50 ¾″ 3.00 1″ 4.50 1¼″ 6.00 2″ 10.00	¾″ x ¾″
Canandaigua, N. Y.	Licensed plumbers	Owner	.....	Owner	No	.....	¾″ x ¾″
Cortland, N. Y.	Licensed plumbers	Owner	0.20	Owner	No	.....	¾″
Dunkirk, N. Y.	Water department	Owner	0.90	Owner	Yes	Included in service charge	¾″
Elmira, N. Y.	Water company	Owner	$10.00 minimum 0.30	Water company	No	.....	¾″
Geneva, N. Y.	Licensed plumbers	Owner	0.40	Owner	Yes	¾″ $4.00 ¾″ 5.00 1″ 6.30	¾″

Glens Falls, N. Y.	Water department	Owner	0.40		Yes	Included in service charge	¾″
Gloversville, N. Y.	Department and licensed plumbers	Owner					¾″ & 1″
Huntington, N. Y.	Plumbers	Owner	0.30	Jointly	Yes	$4.00	¾″
Jamestown, N. Y.	Water department	Water department to curb			No		¾″ & 1″
Kingston, N. Y.	Licensed plumbers	Owner		Owner	Yes	¾″ $7.00 1″ 9.00 1¼″ 12.00	¾″
Little Falls, N. Y.	Licensed plumbers	Owner		Owner	Yes	¾″ 3.00 1″ 3.00	¾″
Mount Vernon, N. Y.	Licensed plumbers	Owner		Owner	Yes	¾″ 4.50 1″ 6.00 1¼″ 8.00	¾″
New Rochelle, N. Y.		Owner		Owner	Yes	¾″ 8.00 1″ 10.00 including pipe and fittings	¾″
Newburgh, N. Y.	Plumbers	Owner		Water department	No		1″
North Tonawanda, N. Y.	Water department	Owner		Owner	Yes	¾″ $ 9.00 1″ 15.00 including service	¾″
Ogdensburg, N. Y.	Water department	Jointly		Jointly	No		1″
Olean, N. Y.	Licensed plumbers	Owner		Owner	No		¾″
Ossining, N. Y.	Licensed plumbers	Owner		Jointly	Yes	$1.00	¾″ to 1″
Peekskill, N. Y.	Licensed plumbers	Owner		Owner	Yes	$7.00 to $10.00	¾″
Rensselaer, N. Y.	Plumbers	Owner		Owner	Yes	¾″-$5.00 including box and curb cock	1″
Seneca Falls, N. Y.	Company and plumbers	Jointly		Jointly	No		1″
Schenectady, N. Y.	Licensed plumbers	Owner		Owner	Yes	¾″ $ 6.00 1″ 9.00 1¼″ 12.00 including curb cock and box	¾″

Information relative to private service lines—Continued

CITY	INSTALLED BY WHOM	PAID BY	PRICE PER FOOT	BY WHOM MAINTAINED	DO YOU CHARGE FOR TAP	IF SO, PRICE FOR SAME	SIZE OF TAP FOR ORDINARY RESIDENCE
Troy, N. Y.	Either	Owner	0.50	Owner	Yes	¾" $ 9.00 1" 12.00 Included in service charge or charge to plumbers	¾"
Utica, N. Y.	Plumbers	Owner	.....	Owner	Yes	¾" $ 2.50 ¾" 3.50 1" 5.00	¾
Waterford, N. Y.	Plumbers	Owner	.....	Owner	Yes	¾" 6.50 ¾" 7.00 1" 7.50	¾ & ¾
Watertown, N. Y.	Water department and plumbers	Jointly	.....	Jointly	Yes	¾" 8.00 1" 10.00	¾"
White Plains, N. Y.	Licensed plumbers	Owner	0.40	Owner	Yes	¾" 7.00 ¾" 8.00 1" 9.00 2" 30.00	¾"
Yonkers, N. Y.	Licensed plumbers	Owner	.....	Owner	Yes	¾" 2.50 ¾" 3.00 ¾" 3.50 ¾" 4.00	¾" to ¾"
Asheville, N. C.	Jointly	Owner	.....	Water department	Yes	$5.00	¾"
Durham, N. C.	Licensed plumbers	Owner	.....	Water company	.....	.....	¾" x 1"
Elizabeth City, N. C.	Jointly	Jointly	.....	Jointly	Yes	$5.50	¾"
Wilmington, N. C.	Jointly	Jointly	.....	Water department	No	.....	¾"
Grand Forks, N. D.	Licensed plumbers	Owner	.....	Owner	No	.....	¾"
Canton, Ohio	Water department	Owner	$5.00	Jointly	Yes	¾" $ 5.00 1" 8.00 1¼" 12.00 1½" 15.00	¾"

Cincinnati, Ohio	Licensed plumbers	Owner		Owner	Yes	¾″ 3.00 1″ 4.00 1½″ 5.00 2″ 6.00	¾″
Columbus, Ohio	Water department	Owner		Water department	Yes	¾″ 12.50 1″ 15.00 Service to curb included	¾″
Conneaut, Ohio	Water company	Owner	$6.50 7.50	Water company			¾″ x ¾″
Delaware, Ohio	Licensed plumbers	Owner		Owner			¾″
Elyria, Ohio	Water department	Owner		Jointly	Yes	¾″ service $16.00 tap included	¾″
Fremont, Ohio	Water department and plumbers	Owner		Jointly	Yes	$12.50 service included	¾″
Marion, Ohio	Water company	Owner	$0.65	Jointly	No		¾″
Massillon, Ohio	Water company	Owner	0.18 0.20	Jointly	Yes	¾″ $5.00 ¾″ 7.00 1″ 9.00	¾″
Middletown, Ohio	Licensed plumbers	Water department		Water department	Yes	¾″ 3.00 1″ 5.00	¾″
Newark, Ohio	Water department to line	Water department		Water department	No		¾″
Piqua, Ohio	Licensed plumbers	Owner		Owner	Yes	$1.00	¾″
Springfield, Ohio	Licensed plumbers	Owner		Owner	Yes	1.65	¾″
Warren, Ohio	Licensed plumbers	Owner		Owner	Yes	2.00	¾″
Youngstown, Ohio	Licensed plumbers	Owner		Owner	Yes	$1.00 to $6.00 according to size	¾″, ¾″, or ¾″
Zanesville, Ohio	Jointly	Owner		Owner	Yes	¾″ $11.00 1″ 12.50 service to curb included	¾″
Guthrie, Okla	Water department	Owner	Cost	Water department	Yes	Cost	¾″
Muskogee, Okla	Licensed plumbers	Owner		Jointly	Yes	$7.00 to $15.00	¾″
Oklahoma City, Okla	Licensed plumbers	Owner		Owner	Yes	¾″ $6.00 1″ 7.00	¾″

Information relative to private service lines—Continued

CITY	INSTALLED BY WHOM	PAID BY	PRICE PER FOOT	BY WHOM MAINTAINED	DO YOU CHARGE FOR TAP	IF SO, PRICE FOR SAME	SIZE OF TAP FOR ORDINARY RESIDENCE
Shawnee, Okla	Licensed plumbers	Owner	$0.15	Owner	No		¾" x ¾"
Dallas, Ore	Water company	Owner	Cost	Owner	Yes	¾" $3.00 1" 5.00 2" 8.00	¾"
Heppner, Ore	Water company	Owner	Cost	Owner	Yes	¾" 3.00 1" 5.00 2" 8.00	¾"
Portland, Ore	Licensed plumbers	Owner		Owner	Yes	¾" and smaller $1.00 1" $3.00 1½" 5.00	¾"
Allentown, Pa	Licensed plumbers	Consumer		Consumer	Yes	¾" 2.50 1" 3.40 1½" 6.50 2" 8.50	¾"
Altoona, Pa	Employees of department	Consumer	$0.88 2.00	Department	No		¾"
Bradford, Pa	Employees of department	Water department		Water department	No		¾"
Erie, Pa	Employees of department			Water department	No		¾"
Duquesne, Pa	Water department	Water department	Line $13.00	Water department	Yes		¾" to 1"
Johnstown, Pa	Plumbers	Owners		Property owners	Yes	¾" $2.00 ¾" 3.00 1" 4.00	¾"
McKeesport, Pa	Water department	Property owners		By department			¾"
Philadelphia, Pa	Licensed plumbers	Property owners		Property owners	Yes	$1.00 with charge for street cut	Any size subject to minimum
Meadville, Pa	By department to curb	Consumers	$6.50 to $10.00	Department			¾"

Nazareth, Pa.	Water company	Consumers	$5.00 line	Water company	$3.00 includes all	.....	.....
New Holland, Pa.	Plumber	Company	.....	Company	Yes	$5.00 to curb	¾″
North East, Pa.	Licensed plumbers	Owner	.....	Owner	No	.....	¾″
Reading, Pa.	Property owners	Owner	.....	Owner	Yes	½″ $2.00 ¾″ 2.00 1″ 3.00	¾″
Sharon, Pa.	Licensed plumbers	Owner	.....	Owner	Yes	$3.50	¾″ and 1″ tap
Shenandoah, Pa.	Licensed plumbers	Owner	.....	Owner	No	.....	1″ tap
Sunbury, Pa.	Water company	Owner	$8.00 to $10.00	Owner	Service line includes all	.....	¾″
Wilkinsburg, Pa.	Either consumers or company	Owner	.....	Owner	Yes	$2.00	¾″
Williamsport, Pa.	Consumer	Consumer	.....	Owner	Yes	$1.00 for ½″ 1.50 for ¾″	¾″
Providence, R. I.	Water department and plumbers	Water department	.....	City	No	½″ or ¾″ $2.75 ¾″ or 1″ 3.25	½″ & ¾″
Charleston, S. C.	Company	Consumer	.....	Company	Included in cost of service	.....	¾″
Columbia, S. C.	Water department	Water department	.....	Water department	Yes	¾″ $ 5.00 1″ 7.50 1½″ 10.00	¾″
Mitchell, S. D.	Licensed plumbers	Owner	$0.50	Owner	Yes	¾″ 3.00	¾″
Clarksville, Tenn.	Licensed plumbers	Owner	0.50	Owner	Yes	$1.00	¾″
Jackson, Tenn.	Licensed plumbers	Owner	.....	Owner	Yes	$2.00 up to 1″	½″ to ¾″
Memphis, Tenn.	Water department	Water department	.....	Water department	No	.....	¾″
Nashville, Tenn.	Licensed plumbers	Consumer	.....	Consumer	No	.....	¾″
Galveston, Texas.	Water department	Owner	.....	Owner	.....	.....	.....
Denison, Texas.	Water department	Water department	.....	Water department	No	.....	¾″
El Paso, Texas.	Water department	Owner	.....	Water department	Yes	.....	¾″

Information relative to private service lines—Continued

CITY	INSTALLED BY WHOM	PAID BY	PRICE PER FOOT	BY WHOM MAINTAINED	DO YOU CHARGE FOR TAP?	IF SO, PRICE FOR SAME	SIZE OF TAP FOR ORDINARY RESIDENCE
Laredo, Texas	Water company	Consumer	.....	Water company	Yes	$5.00 includes service to curb	½" to ¾"
San Antonio, Texas	Plumbers	Consumer	.....	Consumer	Yes	½" $1.00 to 1" $2.00	¾"
Temple, Texas	Licensed plumbers	Property owner	.....	Water department	Yes	½" $3.60 ¾" 4.40 1" 5.20	¾"
Waco, Texas	Licensed plumbers	Property owner	.....	Property owner	Yes	½" 2.50 ¾" 3.50 1" 4.50	½" & ¾"
Ogden, Utah	Licensed plumbers	Property owner	.....	Property owner	Yes	½" 3.50 ¾" 5.00 1" 6.00	¾"
Salt Lake City, Utah	Water department	Property owner	.....	Water department	Yes	$8.00 for ¾" and 1", including tap	¾"-1"-1"
Burlington, Vt	Water department	City	.....	City	No	.....	¾"
Manchester, Vt	Plumbers and department	Consumer	$0.18	Consumer	Yes	½" $5.50 ¾" 6.50	¾"
Rutland, Vt	Department and plumbers	Jointly	.....	Jointly	No	.....	1" tap
Lynchburg, Va	Water department	Water department	$0.30	Water department	No	.....	¾"
Richmond, Va	Water department	.....	.....	Water department	No	.....	¾" to 1"
Roanoke, Va	Water company to curb	Water company	.....	Water company	No	.....	¾"
Anacortes, Wash	Water department	Water department	.....	Water department	Yes	½" $ 8.00 ¾" 10.00 1" 13.00	¾"
Hoquiam, Wash	Water company	Water company	.....	Water company	.....	.....	¾"
Marcus, Wash	Water company	Consumer	.....	Consumer	No	.....	¾"
North Yakima, Wash	Water company	Water company	.....	Water company	No	.....	¾" to 1"
Seattle, Wash	Water department	Jointly	.....	City to property line	Yes	Included in cost of service	½" & ¾"

Spokane, Wash.	Water department to curb	Consumer	.....	Property owner	Yes	At cost	¾"
Tacoma, Wash.	Water department	Consumer	$0.45	Water department	Yes	¾" $ 9.00 1" 12.00 1¼" 15.00	¾"
Walla Walla, Wash.	Water department	Consumer	.....	Water department	Yes	¾" 8.00 1" 10.00 including service	¾"
Ashland, Wis.	Water company	Water company	$0.40	Jointly	Yes	¾" $ 3.25 ¾" 4.00	¾"
LaCrosse, Wis.	Licensed plumbers	Consumer	.....	Property owner	No	.....	¾"
Madison, Wis.	Jointly	Consumer	.....	Jointly	Yes	¾" 17.00 ¾" 19.50	¾" & ¾"
Marinette, Wis.	Plumber	Consumer	.....	Consumer	No	.....	¾"
Racine, Wis.	Plumber	Consumer	.....	Consumer	Yes	¾" 1.50 ¾" 2.00 1" 3.00	¾"
Superior, Wis.	Water company	Consumer	.....	Water company	Yes	$20.00 to $45.00 including everything to curb	¾"
Waukesha, Wis.	Water department	Property owner	$0.66	.....	Yes	Included in cost of service	¾"
Beloit, Wis.	Water company	Consumer	.....	Water company	Yes	$15.00 includes cost of service	¾"
Green Bay, Wis.	Water company	Water company	.....	.....	.....	.....	¾"
Milwaukee, Wis.	Licensed plumbers	Consumer	.....	Consumer	.....	¾" $ 5.00 ¾" 6.00 1" 8.00	¾" & ¾"
Cheyenne, Wyo.	Licensed plumbers	Consumer	$0.50	Consumer	Yes	¾" 15.00 ¾" 20.00 including service	¾"

GRAVITY WATER SUPPLY AT THE CITY OF MANILA, PHILIPPINE ISLANDS

By H. E. Keeler

The city of Manila is the chief city of the Philippine Islands in point of size and wealth and is the capital. It lies on the shore of Manila Bay, a circular body of water some thirty miles across, at whose gateway stands Corregidor, the Gibraltar of the Orient and probably one of the most strongly fortified places in the world.

The city of Manila has a population of a little over 300,000 people, the greater proportion of which are natives, although there is a large population of Japanese, Chinese and other Oriental races and a considerable number of Europeans and Americans.

Prior to the American occupation the Spaniards had control, and governed the Philippine Islands for over three hundred years.

One of the early Spanish gentlemen by name Antonio Careiedo, previous to his death in the year 1748, in his will created a trust fund of $5000 gold for the purpose of constructing a water supply for the city of Manila. The trustees of this bequest for over one hundred years did nothing toward constructing a water-works system.

In the year 1867 Spain sent a new governor general to Manila. He discovered this bequest of Antonio Careiedo and, instituting inquiries, ascertained who the trustees were who had the bequest in charge. He directed that they give an account of the fund with the earnings thereof. Owing to the great length of time which had elapsed during which the fund was in their control, it should have amounted to a very large sum of money, but it was found, when the numerous charges and deductions claimed by the trustees were made, as the funds were depleted by the English when they took Manila and on several other occasions, that it amounted to about $290,000 gold. The governor general ordered them to produce this money and directed the proper officers to proceed with the construction of a water system. However, the work was not begun until 1878. It took eleven years to get the enterprise under way even when it was pushed by this energetic governor general.

In 1878 the authorities began operations and constructed a system, which was placed in service in 1880. The plant as constructed by the Spaniards consisted of a pumping system with a maximum capacity of 6,000,000 gallons per twenty-four hours and a storage reservoir of 16,000,000 gallons. The supply of water was obtained from the Mariquina River at a point five miles above the city. This station and supply is still maintained as a reserve. It is used only for emergencies for the reason, among others, that the quality of the water is not of a satisfactory character.

When the Americans took control of the city of Manila and found that the service and quality of the water supply was unsatisfactory, it was decided that a new source of supply must be secured. A new supply was secured at Montalban at the foot of the mountains, about twenty miles from the city, at a point where the Mariquina River flows through a rocky gorge. The water shed which supplies this new source at Montalban has an area of about one hundred and eight square miles and has been withdrawn from settlement and made a public reservation. No one is allowed to live thereon; no one is allowed to visit the site of the works without a permit from the chief engineer, Department of Water Supply and Sewers; no one is even allowed to camp thereon unless it is a few negritos or what they call the wild men away up in the mountains. The quality as a rule is average, but there is trouble with mollusks, amoebae and decomposing vegetation, so that while it is a vast improvement over the original plant, it is not yet all that is desired. No method of filtration or treatment of the supply has as yet been tried on a large scale. Amoebae pass through all filters ever experimented with at Manila. Preliminary laboratory tests with ultraviolet rays have shown that they destroy bacteria and amoebae as well. The expenditure of the necessary funds for an experimental plant for determining the effect of these rays upon a considerable quantity of water has been authorized. It is hoped that a method of sterilizing water upon a large scale has at last been found. The new supply has a capacity to furnish 24,000,000 gallons per twenty-four hours.

A dam was constructed of stone and concrete across the mouth of the gorge. This dam is 187 feet long, 55 feet high and about 40 feet thick at the base and it is tied into the rocky sides of the cliffs. It forms a storage reservoir, oblong in shape with a storage capacity of about 220,000,000 gallons. Mariquina River water from the

original Spanish station was again used from June 28, 1911, to July 27, 1911, and from March 9, 1912, to May 24, 1912, the water department being obliged to put this reservoir and dam out of commission owing to structural and natural troubles which had developed in the new reservoir and to the deficiency in stream flow. It was found that there were seams in the rocky bottom and sides of the reservoir which caused such a large leakage that they had to cease using it until the leaks could be stopped. During this time the water department was obliged to put into service the old Spanish pumping station and supply the inferior water from the Mariquina River. The new supply was placed in service in 1909 and has been in continual use except for the short length of time required to make the necessary repairs just referred to.

The water is conveyed from the reservoir to the city through ten and one-half miles of 42-inch steel riveted pipe 0.203 inches thick. This pipe is laid with 2 feet of covering and follows the contour of the ground. It is fitted with 6-inch blowoff valves at low places and air valves at high points. Castiron manholes are placed every 500 feet for the purpose of inspection or repair. The pipe was tested to 100 pounds per square inch and the working pressure in no case exceeds 60 pounds. It was dipped in a bath of hot mineral asphalt to prevent corrosion. The plates were received in Manila flat and were rolled into shape and riveted in the local shops. No valves were placed in this line.

At the end of this ten and one-half miles of steel line, the water passes into a concrete-lined conduit about four and one-half miles in length. This conduit is shaped somewhat like a horseshoe, about 5 feet in diameter with an area of about 20 square feet, and is supplied with inspection openings at frequent intervals. This conduit at one point is carried under the bed of the Dulutan River, at another point it is carried over a small river by a 60-foot concrete arch bridge; at another point it is carried 180 feet below the surface of the ground. Where the line crosses the Mariquina River it is carried in a 36-inch castiron main which was laid in a copper dam in the regular way without the use of ball joints.

The water is delivered into two receiving reservoirs located about one and one-half miles from the city proper. One of these reservoirs has a capacity of 18,000,000 gallons and the other 54,000,000 gallons. The larger reservoir is rectangular in plan, measuring 509 feet by 764 feet and is 20 feet deep; its construction involved the

excavation of 275,000 cubic yards of material, the placing of 9,000 cubic yards of concrete and the use of 120,000 pounds of steel. The gatehouse inlet and outlet are so arranged that water may be drawn directly from the head works, directly from the reservoir or from both at the same time. The water surface is 110 feet above sea level (Manila being at elevation 8 feet) which gives a very satisfactory pressure all through the city. The smaller reservoir is connected with the original Spanish pumping station by a 26-inch castiron pipe line and an irregular size tunnel. From these reservoirs the water is delivered into the distribution system. The distribution system is proportioned for a capacity of 30,000,000 gallons per day and consists of about one hundred and ten miles of castiron mains ranging from 42-inch to 6-inch in diameter. No pipe smaller than 6-inch is laid. This conforms to the best modern American practice. All mains are laid with 2 feet cover and are supplied with American made valves. There are connected with the distribution system 630 modern American made double and threeway nozzle fire hydrants with 6-inch connections. These hydrants are exclusively for the use of the fire department and some city departments. There are also connected to the distribution system 230 public singlenozzle hydrants for the use of the poor people, flushing of sewers, street sprinkling and any other general purpose desired. They have now about 6000 service connections ranging in size from 1 to 6 inches. All service connections are made by the city department at the expense of the property holder and the cost is figured from the pipe line to the property line. All plumbing is done by licensed plumbers and their work is carefully and efficiently inspected by City Plumbers.

The water furnished from service connections is sold by cubic meters and by meter measurement only. The meters are paid for by the consumer and are all set by the city and kept in repair by the city at the expense of the consumer. The charge for water when reduced to gallons and U. S. currency is as follows:

Nine cents gold per 1000 gallons for the first 4000 gallons per month.

Eight cents gold per 1000 gallons for all water supplied and passing the meter in excess of the first 4000 per month.

Bills for services are made out by the water department and collected by the city collector. The writer is informed that their loss from delinquent consumers is less than one-fifteenth of one per cent, which is certainly a very creditable showing. Of course they

use the old standard American plan of shutting off the supply to bad or delinquent customers and they only deal with owners, no tenants.

The native population and poor people are supplied with free water from any of the 230 public singlenozzle hydrants heretofore referred to. The people take their supply in buckets or any other receptacle that they may have and carry it from the hydrant to their homes. All public wells in Manila have been condemned, filled up and put out of service, and all the inhabitants are required to use the public supply or distilled water as furnished by the government. The Insular government owns and operates a large plant for furnishing distilled water, ice and refrigeration service. Distilled water is furnished when bottled the army and navy free and to others at a charge of one-half cent per litre and is delivered in sealed bottles or cans in the same way that ice is delivered. Most of the white or foreign population, that is to say the Americans and Europeans and some of the natives, use this supply.

Extensions to the water system are made mostly from the income of the plant and cost about $4000 per mile of main laid for the 6-inch size. The plant has cost about $3,000,000 including a valuation of $500,000 on the original Spanish plant. This money was provided by an issue of bonds.

There are four artesian wells in Manila; two being owned by the United States government and two by private parties. They are 8 inches in diameter and about 700 feet deep. The water does not flow to the surface but does come up to within pumping distance. There are wells used at the Fort McKinley or on the U. S. military reservation which is about five miles from Manila.

The observed result upon the health of the community due to the introduction of the improved water supply has been very marked. There has been a decided reduction in water borne diseases and while the water supply is not entitled to all the credit, it is entitled to a good share of it. Manila has been able to make an excellent showing in its death rate. The reports show as follows:

Among the whites only 12.25 deaths per 1000 population.

Among the natives 32 deaths per 1000 population. The report for 1912 shows a still greater improvement. Of this large death rate among the natives, 63 per cent are of those under five years of age.

This is due to the lack of care and proper attention to the health of children. The death rate compares very favorably with the re-

ports from Chicago, which are 14.25 per 1000, San Francisco 15, New York 16.5, Glasgow 18 and Belfast 22. Of course the white population of Manila contains a large proportion in the prime of life, when the longevity expectancy is greatest.

Again the excellent sewer system in Manila is entitled to some of the credit for the showing they are able to make. In this connection it would be proper and the writer ventures to give a short description of the sewer system as it is in operation in Manila.

Manila is said to be the only city of importance in the Orient, or Far East, that has a complete, up-to-date modern sewer system. The city has constructed at a cost closely approximating $2,000,000 a combined pumping and gravity system. They have fifteen miles of storm water gravity sewers, ranging in size from 12-inch to 96-inch, emptying directly into the river and bay, and seventy miles of sanitary sewers, ranging in size from 8-inch to 72-inch, emptying finally into the bay about two miles off shore. Vitrified pipe is used on all sizes 21-inch and smaller; all pipe larger than 21-inch is made of cement. Owing to the fact that the city is nearly level, it is necessary to carry sanitary sewage to central points and then pump it to a higher level by electrically operated centrifugal pumps to a final delivery into the bay. They have seven of these pumping stations. Extensions to the sewer system are made by the city and generally paid for out of the current revenue. A charge for service is made for all connections to the system equal to 4 cents gold per 1000 gallons for all water supplied the premises as shown by the water meter attached to the customer's service. The consumer may, if desired, furnish a separate meter to measure all water not discharged into the sewers; in such cases no charge is made for the water so measured. All houses are by law required to connect to the sewer system, but when the writer was in Manila in December, 1912, this law was temporarily inoperative owing to injunction proceedings which have not yet been finally decided. (This injunction has been since dissolved.) No sewers were in Manila outside of a few drains prior to American occupation and the great majority of the natives and poor people are still using their pail, vault or tank, which has to be allowed until the courts will permit the enforcement of the compulsory law requiring connections to the sewer system. All sewer connections are of 6-inch vitrified pipe and are made by the sewer department and a charge made to the owner of the premises equal to the cost only. Each is figured at one-half the width of the street.

In conclusion it would seem that these two very important public services have been ably handled by the Americans, and much accomplished in a very short time. It is with pleasure that the writer notes that the superintendent of this service in both departments is a member of this association, namely, Mr. A. Gideon, chief engineer, department of sewer and water works construction.

The writer is under many obligations to Mr. Gideon for the facilities he placed at his command and for courtesies extended while in Manila.

THE USE OF CONCRETE IN WATER WORKS CONSTRUCTION

EDGAR B. KAY

Concrete plain or reinforced is so extensively employed not only in water works but in modern structures of all kinds, that a discussion of its use in the constructions of particular interest to this Association, seems almost unnecessary. Notwithstanding the very general and extensive employment of this material in hydraulic structures, frequent failures or partial failures have resulted from an imperfect knowledge of the physical and chemical properties of various kinds of cements, the proportioning of cements and aggregates, the determination of the amount and proper placing of steel reinforcement in reinforced concrete, the proper mixing and placing of the concrete, inexperience and carelessness in carrying out the construction, improper or premature loading, etc., in addition to the failures directly due to faulty design and faulty construction.

Dr. F. von Emperger in a paper presented at the Sixth Congress of the International Association for Testing Materials says:

> One of the chief causes of such accidents [accidents in building with reinforced concrete] has always resided in imperfect knowledge of the material at the time of removing the false work of the concrete, since in view of the divergent influences to which the material is exposed in building operations, the quality of the material can only be imperfectly judged in the laboratory; or also because, in the absence of any connection between the laboratory and the building site, the material has actually escaped any checking. It has happened, for instance, that the false work has been taken down from concrete which has been spoiled by frost or checked in its development, although the regulations laid down for ordinary average conditions have been strictly complied with; and that this premature dismantling of the false work has led to extensive accidents. Moreover, it has also happened that some contractors have had accidents when working on proved lines, through using materials to which they were not accustomed, without ascertaining whether the same were equal to those with which they were acquainted.

The failure of groined arches at Baltimore's new water filtration plant on October 20, 1913, is reported to have been due to the pre-

mature loading of concrete arches with earth fill without provision for taking up thrusts, the groins acting as cantilevers.

In the official report of Prof. M. Gary, on accelerated test for constancy of volume in Portland cements[1] he says:

> The desire for the discovery of a method of testing which will reveal dangerous changes in the volume of Portland cement with rapidity and reliability is nearly as old as Portland cement itself, and is thoroughly justified.
>
> The evils that can be caused by expanding cement are greater than any that are attributable to any other defect exhibited by hydraulic binding media. Reference may be made to the extensive destruction in the buildings of the Cassel Courts of Justice some years ago, and also to the filtering plant at the new Wannsee water works, near Berlin, in 1911. True, in both cases it was a matter of using material of wrong composition, the injurious effects of which would certainly have been foreseen, even without the aid of any specially sensitive accelerated test, if an examination by the known standard method had been undertaken in good time. Instances may, however, be imagined in which the time available is insufficient for the performance of the cold water block test, which is the only one hitherto considered to be completely reliable, but necessitates the cement block to be kept under observation for several weeks.

With the tremendous growth of the industry and its wide application into new fields, there is no recognized standard test or specification now in use for concrete. There has not as yet been developed a set of standard tests or specifications the use of which will in all cases guarantee entirely satisfactory finished work.

The prescribed standard laboratory tests for the cement and the aggregate may be carefully and accurately carried out, and may show the materials to be good for the purpose, nevertheless if the workmanship is not equal to the materials employed, the result will be disappointing.

In 1903 and 1904 special committees were appointed by the American Society of Civil Engineers, American Society for Testing Materials, American Railway Engineering and Maintenance of Way Association and the Association of American Portland Cement Manufacturers for the purpose of investigating current practice and providing definite information concerning the properties of concrete and reinforced concrete and to recommend necessary factors and formulas required in the design of structures in which these materials are used. This joint committee at meetings at St. Louis in October,

[1] Proceedings Sixth Congress International Association for Testing Materials.

1904, and at New York in the following January perfected its organization and at the St. Louis meeting it was determined to arrange for tests at various technological institutions, some ten or more of which undertook a preliminary series of tests. The results thus obtained were collated and edited by the Secretary of the Committee at the Structural Materials Testing Laboratories of the U. S. Geological Survey at St. Louis. In June, 1905, the U. S. Geological Survey proposed to coöperate with the Joint Committee to the extent of placing the tests made at St. Louis Laboratory at the service of the committee with the privilege of adivsing as to the tests to be made. These tests covered a period of some five years and included a large number of tests of plain and reinforced concrete.

On June 30, 1910, Congress transferred the work of the Survey to the Bureau of Standards together with the data collected. It is understood that arrangements have been made by which the data of the tests will be published as rapidly as conditions permit.

In 1908 the committee began the preparation of the progress report which was submitted to the various organizations represented on the committee.

In the spring of 1911 the work of revising the 1909 progress report was again undertaken. Differences between the members of the committee were discussed and the revised report was finally adopted at a meeting held in New York November 20, 1912. The report was presented and accepted at the annual meeting of the American Society of Civil Engineers on January 15, 1913, and was also presented and adopted at the annual meeting of the American Railway Engineering Association on March 20, 1913, also adopted June 26, 1913, by the American Society for Testing Materials.

CONCRETE IN ANCIENT AND MODERN CONSTRUCTIONS

The increase from 82,000 barrels of Portland cement manufactured in the United States in 1880 to 80,000,000 barrels manufactured in 1911, due to the wide use of concrete in construction, has given popular expression to it as a new industry. Yet hydraulic cement has been employed in the oldest structures of which we have definite knowledge. The Egyptians 4000 years ago made a natural cement which set under water. While Carthage was at the height of her glory, over 2300 years ago, an aqueduct over 70 miles in length was built to furnish a water supply for that city. Natural cement

was used in its construction. To cross a valley over 1000 arches were built, many of them over 100 feet high, some of which are still standing. Cummings in his *American Cements* describing the Carthage aqueducts says that "at one point a piece of masonry over 100 feet long has fallen from the top of the aqueduct to the rocks below and still lies intact, unbroken, illustrating the toughness, tenacity and durability of the natural rock cement used by those early constructors."

E. B. Van Deman in the *American Journal of Archaeology* reviews the practice of construction of Roman buildings, in which he gives the essential features of Roman concrete construction, as found by a personal examination of most or all the concrete buildings belonging in the ten centuries from about 750 B.C. to about 300 A.D. From these examinations he concludes that until the second century B.C. concrete apparently was not in use. Somewhat before 100 B.C. some monumental structures containing concrete were erected. From that time on concrete construction increased in extent of use with considerable variation in its make up and in the nature of the facing. "In no period was concrete used to any extent without facing except in foundations and other invisible parts of buildings. Roughly at the beginning of the Christian era it reached the position of dominant material (or mode) of construction."

Throughout the entire Roman period, concrete was made of lime and pozzuolana (with admixture in some periods of a little neutral sand or gravel), and as aggregate, a considerable range of material, stone, brick and broken tile. During Julius Caesar's reign concrete became quite common for foundations and massive parts of masonry buildings, and some structures of this period are found which are wholly of concrete, with, however, the stone at the face laid or set, rather than deposited irregularly. Under Augustus concrete construction became practically universal, being used for foundations and massive parts of structures, for cores of walls, etc. Broken tile and brick are first found as a concrete aggregate in the period of Augustus and after Nero they are found abundantly. The concrete mortar used in the first and second centuries B.C. was composed of gray to gray-brown pozzuolanic sand with a poorly burned lime rather deficient in quality producing a friable mortar of gray color. Under Julius Caesar, a reddish pozzuolana was brought into use; a better variety of this became the standard mortar material in the

time of Augustus, a clean red pozzuolana which gives a quite characteristic color to the concrete of that period.

Besides the use of concrete in buildings, the Romans used this material for the construction of sewers, water mains, arches, aqueducts and highways.

The dome of the Pantheon, erected, A.D. 123, is perhaps the finest example of concrete construction coming down from the ancients. This structure, which is 142 feet in diameter and contains a 30-foot opening at the top, has withstood the destructive elements for nineteen centuries and is said to show not a crack today.

In the earliest concrete structures the pieces of stone (tufa) employed were very large, the maximum dimension often exceeding a foot. Aggregate that may be described as large continued in use for several centuries, and until broken tiles in large pieces began to appear.

From the downfall of the Roman Empire to the last half of the eighteenth century the manufacture of cement seems to have been discontinued.

In 1756 Smeaton discovered that an argillaceous limestone produced a lime that would set and harden under water, but no immediate appreciation of this knowledge appears to have resulted.

Natural cement was first produced in America in 1818 and reached a maximum production of nearly 10,000,000 barrels in 1899 and has since gradually decreased to about 900,000 barrels in 1911.

The distinguishing features between rubble masonry and concrete are really confined to the methods of mixing and placing the materials. The old Roman concrete was made with large stones and might be classed either as rubble or concrete masonry. The value of either rubble or concrete as a material for construction depends largely upon the quality of the cement used and the care exercised in the mixing and placing.

Examples of masonry structures composed of large stones reinforced or tied together with iron rods and bars are found in the works of all periods, but usually only in connection with cutstone masonry. With the advent of modern concrete the appropriateness of using reinforcing rods or bars of metal was soon discovered and taken advantage of. The compressive resistance of concrete is approximately ten times its tensile resistance. Volume for volume steel costs about fifty times as much as concrete. For the same sectional

areas steel will support in compression thirty times more load than concrete, and in tension three hundred times the load that concrete will carry. For the resistance of compressive loads, concrete will carry a given load at three-fifths or less of the cost required to support it with steel. On the other hand, to support a given load by concrete in tension would cost from five to six times as much as to support it with steel. If the various members of a structure could be so designed that all the compressive stresses are resisted by concrete and steel could be introduced to resist the tensile stresses, each material serving the purpose for which it is cheapest and best adapted, the ideal of economic design would be fulfilled.

CEMENTS

Cements are usually classified as follows: (1) Portland, (2) natural (3) pozzuolana, (4) blended or mixed. At least a score of varieties of hydraulic cement are listed in the classifications of cement technologists, but the American constructing engineer and contractor recognizes only the classes mentioned above. All concrete used in engineering work is made of either Portland, natural or slag cement, and only these three varieties are considered, here. The great bulk of all concrete work is made of Portland cement.

Portland cement is the best of the hydraulic cements. Being made from a rigidly controlled artificial mixture of lime, silica and alumina the product of the best mills is a remarkably strong, uniform and stable material. It is suitable for all classes of concrete work and is the only variety of hydraulic cement allowable for reinforced concrete or for plain concrete designed to endure hard wear or to be used where strength, density and durability of high degree are demanded. Portland cement is the finely ground powder of a clinker resulting from the incipient fusion of the above mentioned calcareous and argillaceous materials and must contain no materials added after calcination other than a small amount of calcium sulphate to regulate setting. The finished product contains at least 1.7 times as much lime, by weight, as silica, alumina and iron oxide combined. Mr. J. Y. Jewett, cement expert for U. S. Reclamation Service, in a paper read before the Sixth Congress of the International Association for Testing Materials, says:

> It is noted, that experience with the several brands used by the Service, both in the form of laboratory tests and of field use, shows that a good cement

can be made by the use of any of the methods and materials enumerated, provided proper care is taken in carrying out the details of the manufacturing process. It may be of interest to note that while these brands, as would be expected, show a diversity of results on the routine acceptance tests, even when meeting the specification requirements, practically all show a tendency to draw together and reach approximately the same values at long time periods.

Natural cement is the finely ground powder of a clinker, resulting from the burning, at a heat below incipient fusion, of argillaceous limestone or other suitable natural rock.

Natural cement may be substituted for Portland in concrete, if economy demands it, for dry unexposed foundations where the load in compression can never exceed, say 75 pounds per square inch (5 tons per square foot) and will not be imposed until three months after placing; for backing or filling in massive concrete or stone masonry where weight and mass are the essential elements; for subpavements of streets, and for sewer foundations.

In mortar natural cement is adapted for ordinary brickwork not subjected to high water pressure or to contact with water until, say, one month after laying, and for ordinary stone masonry where the chief requisite is weight and mass.

Natural cement concrete or mortar should never be allowed to freeze, should never be laid in water, in exposed situations, in columns, beams, floors or building walls, or in marine construction.

Pozzuolana or slag cement is made by intimately mixing granulated blast furnace slag of proper composition with slaked lime, and reducing this mixture to a fine powder. This product differs materially from Portland cement, although it is sometimes called a Portland cement by the manufacturers. While it is an excellent material for many purposes, it possesses certain qualities which prevent its use as a substitute for Portland cement in many classes of work. It will not stand exposure to the air and is very slow setting in tight forms.

Mixtures of Portland and natural cements, unless mixed at the factory and sold as a brand of natural hydraulic cement are not advised under any circumstances. The experience of the writer has shown that it is often difficult to control the use of two kinds of cement on a job, where, otherwise, it might be economic to use Portland cement for part of the work and a natural or pozzuolana cement on other parts. Even where there is no disposition on the part of the contractor to substitute the cheaper kind of cement, there

is the possibility of a mistake being made by careless workmen, and it is better to never allow or to specify the use of different kinds of cement on the same structure.

SAND OR FINE AGGREGATE

The term aggregate includes the stone and sand in concrete and may be classified as fine and coarse. The fine aggregate may be sand or crushed stone or gravel screenings, passing when dry a screen having $\frac{1}{4}$-inch diameter holes. Specifications usually require that sand for concrete shall be clean, sharp, and silicious in character. Neither sharpness nor excessive cleanliness is worth seeking after if it involves much expense. Tests have shown conclusively that sand with rounded grains makes quite as strong a mortar, other things being equal, as does sand with angular grains. The hardness of the separate particles is an important determination, increasing with the age of the concrete. As the cement hardens the aggregates tend to shear through and in the ideal monolith the grains should offer as high a resistance to crushing as the cement, after it has attained its greatest strength. Comparative sand tests of cement sand mortar should be based on compressive strength values instead of tensile strength values, since they conform in most cases to the conditions of actual construction. Concrete is never designed to withstand tensile stresses, without metal reinforcement. Experience has shown that the strengths obtained from a natural sand when made into a mortar of normal consistency are often equal to or greater than those obtained with the same cement, using Ottawa sand. When the same natural sand and cement are made into mortar of work consistency, the reduction of strength will be more or less marked, depending on the character of the natural sand. The strength of all sand mortars is affected by the amount of water used over that required for normal consistency. The more water used the greater will be the loss in strength at early periods. A fine sand takes much more water to produce a certain consistency of mortar when mixed with cement than does a coarse sand. A fine sand makes a weaker mortar than a coarse because of the lower density. It follows that if a mortar is less dense it must have more voids, and in the first mixing of the mortar these voids are filled with water. Hence when a mortar does require an excess of water, it is evident that the mortar produced will be less dense, and consequently will have lower strength. J. P. Brooks in *Reinforced Concrete* says:

By means of three tests that are readily made the relative value of various sands may be judged quite accurately. They are: (a) the appearance; (b) the feeling; (c) the weight. The better sands show a generous sprinkling of coarse grains mixed with the fine material and intermediate gradations. The grains should be of irregular shapes even though smooth; but sharpness is desirable. Upon rubbing the sand in the palm of the hand, traces of clay should be seen. The heavier the sand the better. Well shaken sand should weigh over 100 pounds per cubic foot when dry.

The only substitute for natural sand for concrete, that need be considered, is pulverized stone, either dust and fine screening produced in crushing rock or an artificial sand made by reducing suitable rocks to powder. The danger in using stone dust is failure to secure the proper balance of different size grains. The coarseness as well as the fineness of a good concrete sand is limited. The best sands will show not more than 40 per cent retained on the No. 10 sieve and not more than 5 per cent passing the No. 80 sieve.

PROPORTIONING CONCRETE

American engineers and contractors proportion concrete mixtures by measure, thus a 1–3–5 concrete is composed of 1 volume of cement, 3 volumes of sand and 5 volumes of aggregate. The volumetric method of proportioning is much more convenient in the field than to weigh the ingredients of each batch. In Continental Europe the gravimetric method of proportioning is very generally employed.

Depending upon the required density of the concrete, the task of proportioning consists in so proportioning the several materials that all void spaces are filled with finer material,—the voids between the larger aggregates being filled with the sand or fine aggregate, the voids between the sand filled with cement, and all aggregates large and small thoroughly coated with the cement paste.

Upon large or important structures it pays from an economic standpoint to make very careful studies of the materials of the aggregates and their relative proportions. Cement is always the most expensive ingredient, and any reduction of its quantity, which may very frequently be made by adjusting the proportions of the aggregate so as to use less cement and yet produce a concrete with the same density, strength and inpermeability, is of the utmost importance. Mr. W. B. Fuller has shown that by changing the ordinary mixture for watertight concrete, which is about 1: $2\frac{1}{2}$: $4\frac{1}{2}$, which requires 1.37 barrels of cement per cubic yard of concrete, by carefully grading

the materials by methods of mechanical analysis, he was able to obtain watertight work with a mixture of about 1: 3: 7, thus using 1.01 barrels of cement per cubic yard of concrete. This saving of 0.36 barrel is equivalent, with Portland cement at $1.60 per barrel to $0.58 per cubic yard of concrete.

The principles underlying the correct proportions of the materials are the same as those for mortar, namely, that the mass compacted shall have the greatest possible density. The theory of a concrete mixture has been well stated by Mr. Feret, as follows:

> The problem of making the best concrete is thus reduced to the selection of a mixture of materials whose granulometric composition corresponds to the maximum density, since when this composition is known, absolute volumes of cement may be substituted for equal absolute volumes of fine sand and vice-versa, so as to vary the strength, as desired while the density remains the same.

This is not strictly true for concrete mixtures because, when water is added to dry cement, the cement particles are separated from each other by the surface tension of the film of water, and it is not possible to obtain as dense a mixture as will be given by the dry mixture.

The density of concrete depends upon the varying degree of roughness of the stone and sand, the relative sizes of the diameters of the stone, sand and cement, and the amount of water used.

When loose sand is mixed with water, its volume or bulk is increased. Subsequent jarring will decrease its volume, but still leave a net gain of about 10 per cent. Not only does this increase in the volume of the sand occur, but, instead of increasing the voids that can be filled with cement, there is an absolute loss in the volume of available voids, due to the space occupied by the water necessary to bring the sand to the consistency of mortar.

When loose, dry Portland cement is wetted, it shrinks about 15 per cent in volume behaving differently from the sand, but it never shrinks back to quite as small a volume as it occupied when packed tightly in a barrel. The amount of cement paste that different brands of Portland cement will produce varies from 3.2 cubic feet based on a barrel of 3.8 cubic feet and for cement weighing 100 pounds per cubic foot there will be produced 0.86 cubic foot of paste.

Extensive tables of quantities of materials required in proportioning concrete for various mixtures are to be found in such treatises as *Concrete, Plain and Reinforced*, by Taylor and Thompson; *Concrete and Reinforced Concrete* by Reid; *Concrete Construction Methods and Cost* by Gillete and Hill.

MIXING AND PLACING CONCRETE

Mixing may be done either by hand or machine and the method to be employed is determined principally by the size of the job. A better and more uniform concrete can be made with a good machine mixer than by hand. A plastic concrete of a jelly-like consistency always produces stronger concrete than a wet mix and is preferred where conditions will admit of its use. It is absolutely necessary however, in reinforced concrete to employ a consistency sufficiently wet to flow around the steel and into the corners of the forms and in rubble concrete, to flow around the large stones. The batch type mixing machine should be used.

In handling and placing concrete, the materials must remain perfectly mixed, the aggregate must not separate from the mortar and the concrete must be rammed or agitated so as to thoroughly fill the forms and surround all parts of the steel reinforcement. Care must be taken to remove all sticks, blocks, shavings or similar materials from the forms before the concrete is placed and in case new concrete is deposited on a layer that has already set, the old surface should be roughened, cleaned and drenched with water before the new material is added. Concrete should be wet frequently for a few days after it is laid. The bonding of old and new concrete in walls or locations liable to tensile stress should be made by the use of a mortar richer in cement than the mortar in the concrete, a proportion of 1 to 2 is commonly employed.

The adhesive strength of cement or concrete is much less than its cohesive strength, so that in building thin walls for a tank or other work which must be watertight, the only sure method is to lay the structure as a monolith, without joints.

The placing of concrete under water requires the greatest care to prevent the cement from being washed out. Under no circumstances should concrete be placed in running water. Exposed concrete walls should not be plastered. It is a needless expense, and results in variable climates are unsatisfactory. It is difficult to apply cement mortar uniformly on the face of hardened concrete, and it is apt to crack off and discolor, especially if the concrete behind it is porous enough for water to penetrate it.

WATER-TIGHTNESS

A wall of concrete may be rendered water-tight in various ways:

1. By accurately grading and proportioning the aggregates and the cement. The proportions employed to resist the percolation of water usually range from 1:1:2 to 1:2½:4½ the most common mixture being 1:2:4 or 1:2½:4½. With accurate grading by scientific methods, water-tight work may be obtained. For maximum water-tightness a mortar or concrete may require a slightly larger proportion of fine grains in the sand than for maximum density or strength. In general it may be stated that in monolithic construction a wet mixture, a rich concrete and an aggregate proportioned to secure great density will in the majority of cases give the desired results. It is impossible to specify definite thicknesses of concrete to prevent percolation under different heads of water, because of variations in proportions and methods of laying.

2. By special treatment of the surface of the concrete. Various methods have been employed, such as plastering the surface of concrete with rich portland cement mortar in proportions 1:1 or 1:1½. Water-tightness may also be secured by the use of a granolithic finish; by troweling the surface so as to produce a hard finish. Layers of water-proof paper or felt cemented with asphalt or bitumen or tar are extensively used, and sometimes asphalt alone. A mixture of alum and lye has also been used.

3. A water-proof concrete can be prepared by the application of fluates. The operation however, requires a great deal of time and labor. By the application of an 8 per cent solution of potash soap, instead of water, in mixing, the concrete can be rendered water-proof, so as to fulfill all requirements as to permeability of water.[2]

The first method suggested, is unquestionably the best to secure permanent water-tightness and the writer is not in favor of using water-proofing ingredients or of making surface applications except in cases where such may be required by reason of imperfections in the original concrete.

EXPANSION AND CONTRACTION

The coefficient of expansion of concrete is practically the same as for steel, about 0.0000065. Concrete is sensitive to temperature

[2] See Waterproof Concrete, by Albert Grittner, *Proceedings Sixth Congress International Association for Testing Materials.*

changes and expansion joints should be provided in all retaining walls not reinforced to take temperature stresses every 30 to 40 feet throughout the length of the structure. Prof. A. L. Johnson has attempted a mathematical demonstration of how to prevent contraction as follows:

Continuous walls will crack vertically in lengths such that the weight of the section multiplied by the coefficient of friction on the soil is equal to the tensile strength of the wall. The temperature required to crack the wall in these lengths is that temperature requiring a shrinkage in excess of the ability of the wall to stretch. Now, plain concrete can stretch very little before cracking. But concrete thoroughly reinforced with metal can take a proportionate elongation of 0.0018 before cracks will be developed. The maximum shrinkage that would be required, could not be due to a fall in temperature of more than 125°, The coefficient of expansion of concrete is 0.0000055, which for 125° becomes 0.0007 per unit of length, or less than one-half the ability of the reinforced concrete to stretch. No crack, therefore, could be produced with a fall in temperature of less than 250°, which of course, would be impossible to realize in practice. The quantity of metal used should be enough to equal the tensile strength of the concerte at the elastic limit of the metal. Calling the tensile strength of stone concrete 200 pounds per square inch, and the elastic limit of the steel 55,000 pounds (for high carbon steel) per square inch, the number of square inches of steel required would be $\frac{1}{275}$ of the number of square inches in the wall section.

Reinforced concrete retaining walls are commonly built without expansion joints. No amount of reinforcement can entirely prevent contraction cracks. The reinforcement will, however, distribute the cracks uniformly over the section; the greater the amount of reinforcement the smaller the cracks. The size and the distribution of the cracks will also depend upon the bond strength of the rods (Ketchum).

The American Railway Engineering Association has adopted the following:

Reinforcement for shrinkage or temperature stresses shall be not less than 0.33 per cent of a form of bar capable of developing a high bond resistance and shall be placed near the exposed surface of the concrete.

In calculating the steel required to reinforce for expansion and contraction, the temperature stresses in the steel must be considered.

If the steel drop in temperature 100° the temperature stress in the steel = 100 × 0.0000065 × 30,000,000 = 19,500 pounds per square inch. If the tensile strength of the concrete be 200 pounds per square inch and the elastic limit of the steel be 60,000 pounds per square inch, the available stress in the steel = 60,000 − 19,500 = 40,500

pounds per square inch and the required percentage of steel is $p = \frac{200}{40{,}500} = 0.0049$ or 0.49 per cent. While calculations show that the percentage of longitudinal steel reinforcement for expansion and contraction should be from 0.4 to 0.67 per cent, depending upon the elastic limit of the steel employed, yet experience has shown that walls reinforced with from 0.1 to 0.3 per cent of steel have given very satisfactory results, where the foundations are stable. Where there is any tendency for the wall to be thrown out of alignment the full amount of reinforcement should be used. The reinforcing steel for temperature stresses should be placed as near the exposed faces as practicable, and the rods should preferably be of small size.

BRIEF REVIEW OF SEWAGE DISPOSAL WORKS IN SOME EUROPEAN CITIES AND COMPARISON WITH THE PENNYPACK CREEK WORKS AT PHILADELPHIA

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Introduction. The use of underground channels to carry off the liquid wastes from dwellings is a very ancient practice.

In the beginnings of ancient Rome there were built large conduits, in use to this day.

On the Island of Crete, the home of the Aryan progenitors of the ancient Grecians, recent excavations show that underground drainage channels were systematically constructed at least 3500 years B.C.

The construction of these channels as a system however may be said to have begun in the nineteenth century.

Scientific and effective treatment and disposal of the liquid wastes was discussed in the last quarter of the nineteenth century, experiments inaugurated and many works constructed during that time; but during the early years of the present century, the art has made much progress, works have been built in accordance with the most successful lines of experiment, and many additions made to the earlier works.

Sanitation. While sanitation comprises many branches, that represented by the term sewage disposal is one of large influence upon the general health of a community.

Prior to the introduction of sewage systems in large cities, death rates were high, and for centuries at intervals of a few years or decades, their populations were swept away by plague or pestilence, fostered and spread by admixture of noisome liquid wastes with the drinking water.

Repetitions of these visitations were accepted as natural, until modern science showed that by the introduction of proper systems for carrying away liquid wastes, the mortality could be lessened.

Striking examples are the city of Havana, and the Canal Zone, made habitable and safe by the introduction of sanitary conveniences.

Municipalities, especially in the crowded European centers, took up the matter of improving old conditions with vigor, full size experimental installations were made, gradually developing into complete systems for the collection and disposal of the sewage.

The agitation for better sanitary municipal surroundings has given rise to keen debates and has set up many champions of a radical change, calling for the exclusion of sewage matters from streams and rivers.

Calmer judgment and extensive experiments have tempered these views until at present it is recognized that the streams themselves are and have been effective agents in transforming organic or putrescible matter into a mineral or innocuous state up to a certain limit, dependent upon the amount of available oxygen in the water.

European conditions. The examinations of sewerage systems in European cities are valuable on account of the concentrated population, a prototype of our own in another half-century, and the results achieved by the introduction of sewage treatment systems in lowering their death rates, even with a water consumption of from one-fourth to one-sixth of that in our American cities. This, resulting in a far more concentrated sewage, calling for different treatment than our own, necessitates also the treatment of a volume of storm water when polluted by the sewage, ranging from four to six times the dry weather flow, a condition which does not arise with our more dilute sewages.

By reason of their concentrated populations and the smaller size of European rivers, with their small diluting volumes, the urgency of installing sewage treatment works has been greater, to protect their restricted water supplies and to avoid nuisances that would in some cases make their cities noisome places of abode.

Again, on account of their nearness to Asiatic cities, the homes of plague and pestilence and their open harbors, sanitary safeguards are essential.

Owing to restricted parking areas and the possibilities of river embellishment, by the removal of sewage pollution, they have been enabled to make of their rivers the most attractive features of their cities, for bathing and the enjoyment of people in their hours of relaxation.

American conditions. The American cities have grown rapidly from villages, and the village practice of building a culvert to the nearest stream has until recent years, survived. The drains from

various villages have grown into a system with many outlets discharging crude sewage into the larger streams.

Large streams like the Schuylkill River suitable for water supply have gradually been eliminated from the lists of available sources, the rivers themselves have become septic tanks, and of recent years, even rivers like the Delaware and Hudson have been polluted, so as to require effective treatment before their waters can be used for domestic consumption, a prodigal waste of natural resources.

A few years ago the old fashioned cesspool was in vogue and we can remember when protests were filed against the building of sewers. Now, since no block of dwellings can be disposed of without them, builders solicit drainage facilities as the first step in the improvement.

A few years ago black, dirty, sewage polluted water was consumed by local residents without question and affliction with enteric diseases in consequence was taken as a matter of course. The improved water supply has educated our people to other views.

In port operations, formerly, any filth could be thrown from vessels or dumped into the river. Today it is recognized that to compete for the world's commerce, we must remove from sight and smell all nuisance.

Today pollution of water supplies will not be tolerated, and a reduction in the deaths due to preventable disease appeals so strongly, that the great insurance companies have banded themselves together, with millions of capital behind them, to study their causes and remedies with a view to stamping them out.

We in America are just learning to be less prodigal and to devise ways and means to conserve our advantages, to protect our streams, to be dissatisfied with their pollution with sewage; but it will take some educational compaigning before the people at large will understand the value to the communities of sewage treatment.

Advances in the art. The advance made in the art, due to large sums spent in full size experimental installations, in efforts to free natural water courses from pollution, has been steady and positive, each forward step taken after experience in operation or research warranted it.

In the first instance, farms irrigated with sewage were operated, but this practice has been abandoned, except where by reason of the great cost of the installation, it is not practicable to change the treatment.

Screening and tank treatment, sometimes coupled with sand filtration have been substituted in some instances.

Throughout England, where rivers are comparatively small, plants are undergoing reconstruction, and some form of bacterial treatment in beds is being added to the preliminary treatment. In some cases it has been found to be economical to turn the earlier works into scrap and build entirely new as at Leeds.

In English sewage disposal plants, the disposal of sludge, except where it is carried to sea, has been generally inadequate. This is now considered by many the most vital problem.

In Germany, by several processes the problem of sludge disposal has been successfully solved.

As to the present status of the art the following statements may safely be made:

Sewage even of exceptional concentration can be effectively treated, so as to secure a clear, odorless, sparkling, non-putrescible effluent before discharging into a stream, the securing of which is a matter of cost and therefore an economic as well as a constructive problem.

Sludge resulting from sewage treatment can be rendered innocuous, practically inodorous, wholly unobjectionable, after which it may be dealt with in various ways.

Desired results may be secured by certain combinations of treatment at a fraction of the cost of other recognized scientific methods of treatment, in satisfactory operation.

Relation to water supply. It is considered by some eminent sanitary engineers, that they are justified in placing sewage disposal next in importance to water supply in the list of public utilities. This is based upon the value of protecting the streams from nuisance, to conserve sources of water supply and to protect the health of the people.

As a water supply is taken from a river, its application to a populous community produces sewage and as its natural destination is a return to the stream, used possibly again for water supply, it gives rise to an economic problem as to the proportionate share which should be borne in the treatment of both the water and sewage.

The theory of excluding all sewage from return to a stream, held some years ago is untenable, and with this recognized and the necessity of utilizing the diluting volume of the river and its available oxygen to continue the treatment begun in disposal works, the problem resolves itself into an economic one.

The uses to which the waters of a river are to be applied are controlling factors in the standard of effluent to be secured.

The comparative economy of treating sewage to a high degree of purification, or of taking a lower standard and increasing the degree of water treatment, must be solved by each community.

When comparing the amounts of available chlorine required in water and sewage effluent treatments it has been found that of three turbid raw water supplies, the average amount of available chlorine required to render the manufactured product free from bacteria resembling B. Coli is p.p.m. 0.7; of three other raw surface waters 0.3; of four examples of sand filter effluent, there were required 0.33.

For the effluent of sewage works under average conditions, which had been subjected to settlement, there were required 6 parts; that which had passed percolating filters, 3 parts, and that which had in addition been subjected to secondary settling, 2 parts.

In general therefore it is cheaper to treat water when practical disinfection can be secured by the admixture of from 0.3 to 0.7 p.p.m. of available chlorine instead of attempting to secure an uncertain comparative result in the treatment of sewage effluent by the admixture of from 2 to 6 parts, with a probability of having to resort to an equal amount of treatment for the water notwithstanding the sewage treatment.

In Germany, with its concentrated populations, rivers are considered by the rivers boards as proper places for the disposal by dilution of sewage submitted to fine screening and settling tank treatment, from which rivers are taken the water supplies usually from driven wells or filter galleries along their banks.

Judging from the exceptionally low typhoid death rates in these cities any condemnation of the practice must be supported by arguments from other sources.

City systems. Old Frankfurt, Dresden, London. Description of collecting systems, and local river results.

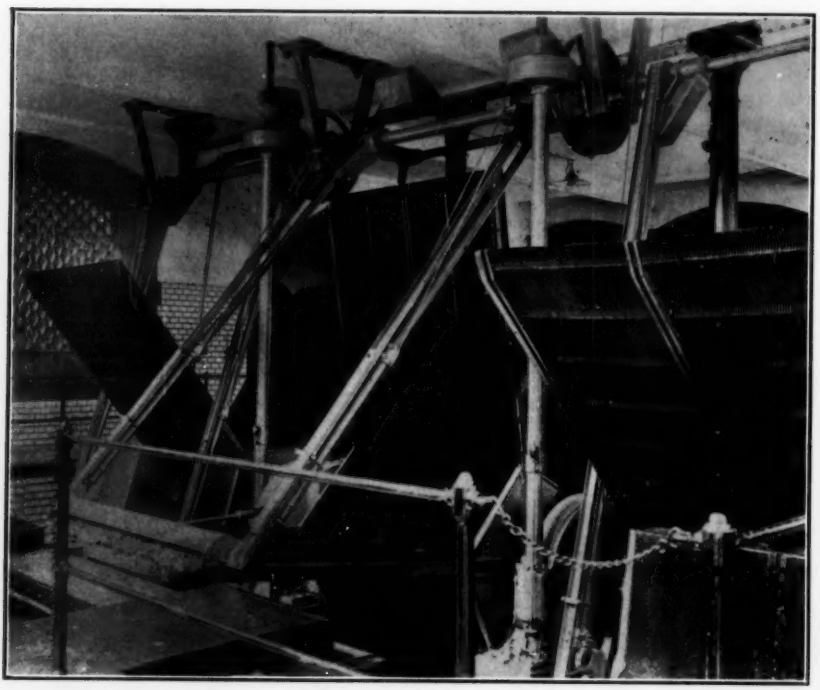
Sewer sections. Two views Wiesbaden. Description of materials and methods of construction, purposes and accomplishments referring to cleanliness, lack of odor and smoothness.

Irrigation farms. Two views Berlin. Berlin: Description of length of force mains; areas of farms in service 22,850 acres; applicability of farms; rate 25,000 gallons per acre; force mains 9 to 15 miles long.

German works. Frankfurt, Hamburg, Dresden.

English works. Birmingham, Bradford.

Grit chambers. Frankfurt, Huddersfield. Sewage reaching treatment works from a combined sewer system must be subjected to passage through a grit chamber to remove sand and coarse gravel. This is accomplished by an increased flow area, to reduce the velocity to 15 inches per second or less. The types in use in Frankfurt, Dusseldorf and in the Emscher district are good examples. Deposited solids are usually removed by elevator bucket dredges having trans-



FINE RAKES OR SCREENS AT FRANKFURT A. MAIN

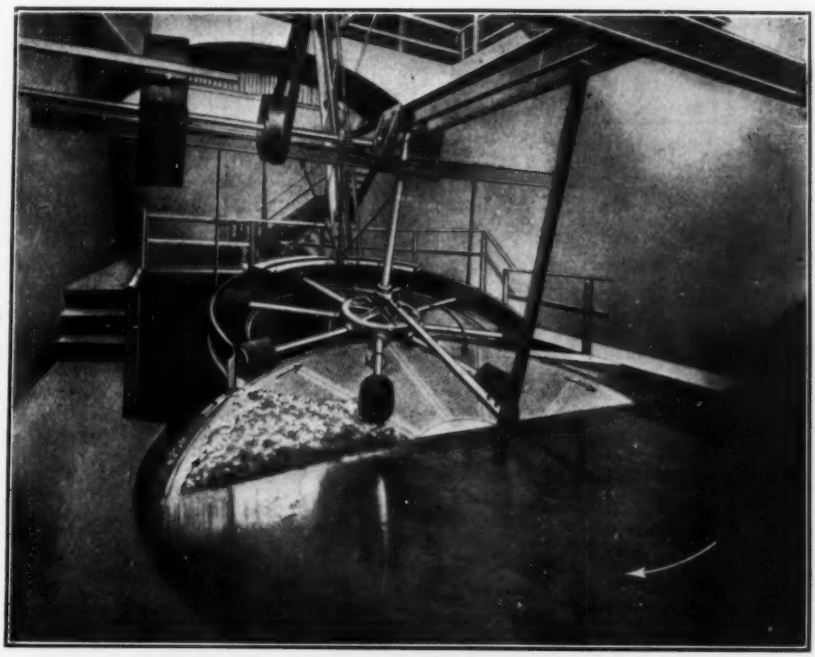
verse motion on tracks. This admits of operation without putting the grit chamber out of service.

Screens. Hamburg, Frankfurt, Dresden, Bolton. Screening in England is for the purpose of removing such solids as would clog pumps or would be not readily reduced in tank treatment, therefore it is coarse screening the bars being spaced about 2 inches.

In Germany, however, it is considered in many places as a complete and efficient treatment, therefore their manufacture and maintenance

have received much more attention. Usually there is a coarse screen of about 3 inches spacing composed of bars to protect pumps or valves. The screening processes proper consist in the main of three types designated as Hamburg, Frankfurt and Dresden.

The Hamburg type consists of a curtain inclined at an angle running over drums, brush cleaned. The apertures of the screen are about $\frac{3}{8}$ inch. Where there is a large tidal range and fluctuating depth in the sewers, this is most effective and can be operated with slight nuisance although it is cleaned by brush with difficulty.



FINE SCREEN OF REINSCH TYPE, DRESDEN, GERMANY

The Frankfurt screen consists of five vanes cleaned by a comb the prongs of which alternate with the spaces of the screen. The combings are passed to a table which disappears under a knife edge, the scrapings going to a belt, the screen being easily cleaned and very efficient.

The Dresden screen, introduced in about fifty European plants in Germany, Austria and Russia is the most improved and simplest in its operation. The cleanliness that can be maintained is hard to

EMSCHER TANKS SHOWING PROXIMITY OF BUILDINGS, SEWAGE DISPOSAL WORKS AT ESSEN-NORD, GERMANY

believe unless seen, being entirely without nuisance or objectionable features. The spacing is about $\frac{1}{12}$ inch. Its efficiency will average over 50 per cent solids removed. Screens however effective cannot compete with properly designed tanks.

Tanks. Frankfurt, Birmingham, Essen 2. Without entering into the comparative merits of settling, septic, sedimentation, Emscher or other forms of tanks, a number of types are shown.

Where the sizes of rivers and the consequent dilution is large, and water supplies are not jeopardized, the rivers boards of Germany have after examination pronounced fine screening of sewage a sufficient protection of the rivers.

Where smaller rivers must be used for final disposal or water supplies must be protected there is added some form of tankage treatment.

Septic tanks as at Wilmersdorf deal with a concentrated sewage, are foul smelling though the final effluent is satisfactory.

In sedimentation tanks as at Frankfurt, each unit has a storage period of one and one-half hour; cleaning is resorted to once a week. The type tank involves the placing of a unit out of service when being cleaned, resulting in odors noticeable underground at 150 feet distance.

Throughout England the septic tank is in use designed for storage periods of from twelve to twenty-four hours.

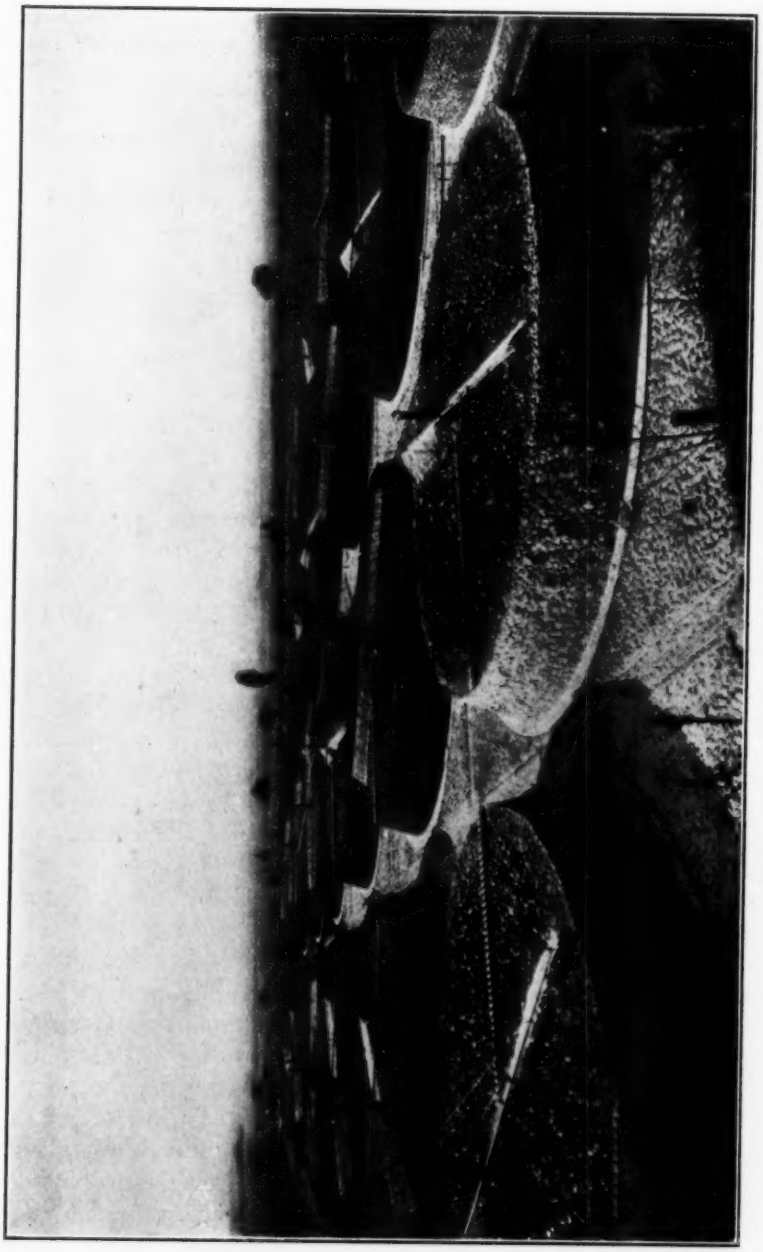
The difference between the German practice of about two hours and the English practice of eighteen hours storage, calling for from five to ten times larger tankage area, is due to the smallness of the English rivers, and the necessity of taking out as large a percentage of solids as practicable.

Methods of cleaning tanks of deposit are various, that at Bolton, consisting of a squeegee having considerable merit.

At Frankfurt the sloping sides and bottom enable the sludge to flow to a central sump, whence it is pumped to centrifugal dryers.

Compare the area of the tanks in Birmingham (12 acres) for 900,000 inhabitants with that of Essen Nord ($\frac{1}{2}$ acre) for 190,000 which illustrates the difference in area as given above, required according to the practice in these two countries.

The so-called two-story tanks called Emscher tanks because used in the Emscher district are two fold in their operation. They provide a sedimentation chamber for about two hours storage, and a digestion chamber for sludge, there being a diaphragm to separate the liquid



PERCOLATING FILTERS AT WILMERSDORF, GERMANY

from the solid parts of the sewage. The gases generated by the decomposing sludge do not pass through the sedimentation chamber, therefore the liquid remains fresh as distinguished from septic or smelly sewage. The biological processes carried on in the digestion chamber successfully mineralize the sludge, so that when withdrawn usually by hydraulic pressure, due to difference in head between tank water and sludge outlet, the product is without objectionable odor, and is like garden soil, suitable for filling in low ground if not utilized for fertilizer.

The tank can be cleaned without placing out of service, and is today on many points the most efficient type in use.

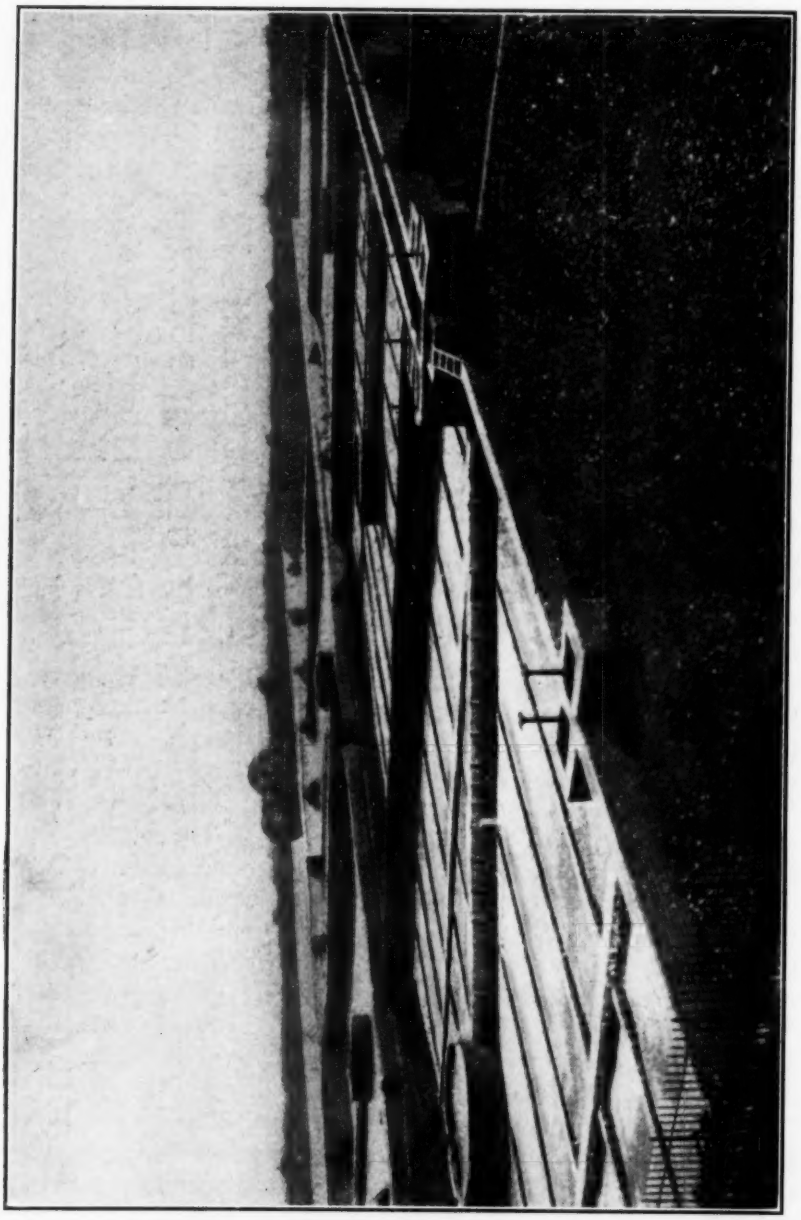
Tank treatment even with long storage periods without supplementary treatment is not sufficient to prevent extreme pollution of the small English rivers, whereas with the larger German rivers, it is efficient, with short storage periods.

Contact beds. Sheffield. A form of bacterial bed in use largely in England and America is the contact bed, consisting of a basin enclosed by walls, filled with cinders, fine stone or other materials, into which sewage, usually after being submitted to tank treatment, is admitted slowly, allowed to stand some hours, then slowly emptied, and allowed to stand empty for some hours, the oxygen admitted during the withdrawal of the liquid serving to provide food for the bacteria acting upon the solids attached to the surface of the material in the bed. The so-called slate beds may be so classed because of the similarity of operation.

Two good examples are at Manchester and at Sheffield, the first caring for the sewage of about 250,000, the latter of about 470,000 inhabitants.

The process is regarded as effective but as the amounts that can be treated are small, about 500,000 gallons per acre per day, about one-fourth of the amount which may be treated in other more rapid processes, percolating filters for example, with a consequent larger area and larger maintenance charges, more intensive processes are talked about, but as much capital is locked up in such large plants it is difficult to make radical changes.

Percolating filters. Wilmersdorf, Birmingham, Huddersfield, Bolton, Salford. Percolating filters consist of beds of cinder, broken stone, gravel or other hard material, thoroughly underdrained, upon which the sewage, subjected to preliminary treatment, is applied by some form of distributor, usually to spray the liquid; rotating arms,



CONTACT BEDS AT SHEFFIELD, ENGLAND

longitudinally travelling trough, fixed nozzles, or by means of a net work of perforated pipes laid on the surface of the filter. With the exception of the circular filters 65 in number at Wilmersdorf near Berlin with rotating arms, and a few small scattered examples, there are none of these beds in Germany, although experimental installations have been in use, and their ultimate use is forecasted, notably in Hamburg and Leipzig.

An experimental station of large size has been in operation in connection with the work at Paris, France, as a result of which the speaker was informed by M. Verrière the chief engineer, that in the forthcoming report for the remodelling of the system, percolating filters would be recommended, in place of the existing farms.

In England the use of the percolating filter is most extensive, not as a matter of choice but from necessity.

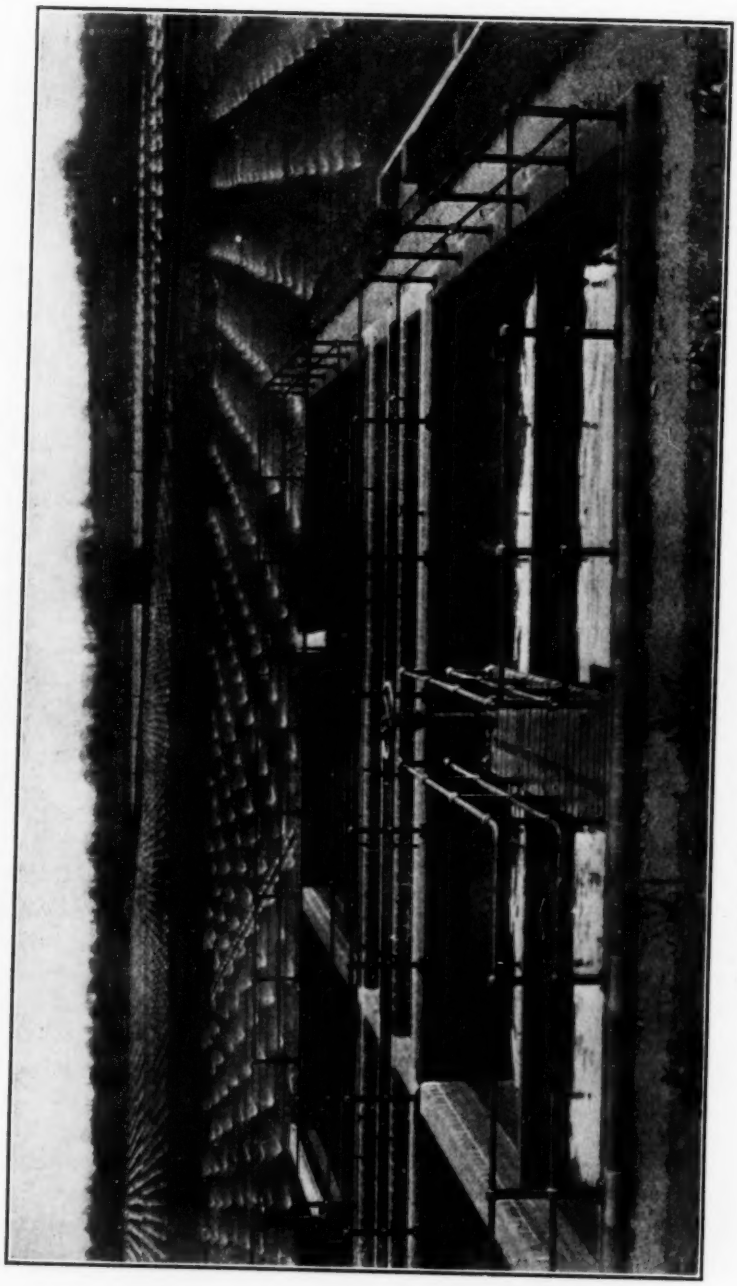
The prevalence of cities with large populations, and the many manufacturing villages forming a chain between, with the comparatively small sizes of the rivers and the great amount of pollution which reaches them, in some cases equalling their flow volumes, have forced more complete treatment of waste liquids than can be obtained by screening and tank treatment alone. This is especially the case in the manufacturing sections, Warwickshire, Lancashire and Yorkshire. Ten years ago it was the view of Sanitary Engineers that septic tanks would reduce and liquefy 90 per cent of the sludge deposited in them; now it is known that between 10 and 20 per cent is the average reduction.

Within twenty years millions of pounds sterling have been expended upon works, but some are being consigned entirely to the scrap heap, as at Leeds, many others are being planned to supplement present treatment by percolating filters, and many are in a process of alteration.

When it is considered that by resorting to these filters the rate of treatment for English sewages can be doubled over the best contact bed system, the matter of area of ground and construction cost alone shows economy.

With strong English sewages composed largely of manufacturing wastes, there is considerable odor from these spraying filters. The small white moths or flies that infest them are an intolerable pest. Experience shows that this nuisance is greatly reduced by surrounding the filters with close stone walls, and placing a fine surface medium.

Sludge disposal. Of all matters reaching a sewage treatment plant, that of proper disposal of the sludge, or residue from tankage



SILT TANKS AND PERCOLATING FILTERS, BIRMINGHAM, ENGLAND

treatment is the most serious. A dozen plants can be named, the efficiency of each of which from an operating standpoint is unquestioned, with the single exception of sludge disposal. The methods of disposal vary with the local conditions. They comprise, irrigating on farm land, underdrained lagoons, burying in trenches, pressing and drying, centrifugal drying machines, briquetting and burning, canal boats to farms, steamer to sea, digestion in tanks and drying on sand beds, then used for filling.

The effectiveness from the standpoint of lack of nuisance about the works is as follows: (1) digestion, drying and filling, (2) steamer to sea, (3) drying under heat. The remaining methods are ineffective.

1. The speaker has stood in the center of a 6-acre tract of air dried sludge 50 per cent moisture, of depth varying from 3 to 12 feet, in damp weather, without detecting any more odor than would be noticed from a freshly ploughed unfertilized field. Example—All over the Essen district.

2. Pumping to steamer and disposal at sea is positive in the removal of all nuisance, except during cleaning of tanks. Examples—London and Manchester.

3. During cleaning of tanks and during drying by centrifugals, it is smelly within the building, after drying by heat, there is no further objectionable odor. Example—Frankfurt a. Main.

It may positively be asserted therefore that with certain treatments the sludge problem is satisfactorily solved.

When sufficient fats are present in the sludge (about 25 per cent) they may be profitably recovered as at Bradford.

Notable treatment works. Notable as being the best of their kinds are the following works:

Hamburg—Grit chamber screening and dilution in the Elbe.

Dresden—Grit chamber andfine screening with dilution in the Elbe.

Vienna—Efficient collecting systems with dilution in the Danube.

Frankfurt a. Main—Grit chambers, screens, settling tanks, sludge dried in centrifugals, further dried by heat and burnt under boilers to produce electric current.

Wilmersdorf—Primary settling tanks, percolating filters, secondary tanks, sand filtration, sludge in lagoons.

Cologne and Dusseldorf—Fine screening and tankage, with dilution in the Rhine.

Berlin and Paris—Farms.

London—Screens and tanks with dilution in the Thames, sludge to sea.

Manchester and Sheffield—Screens, tanks and contact beds.

Birmingham—Detritus tanks, settling tanks and percolating filters. Sludge to lagoons.

Salford—Grit chambers, settling tanks, roughing filter, percolating filters, sludge mixed with chemicals, pressed and dried.

Many others will outclass these when new works shall be in operation.

River fronts. One of the most noticeable results of the establishment of sewage disposal works, is in the ability to improve and embellish river fronts.

In London not many decades ago the stench from the sewage polluted Thames invaded the Houses of Parliament and pleaded the cause of sewage treatment. The cleaning up of the Seine at Paris, the Spree at Berlin and other rivers was accomplished only after centuries of warning sounded by the periodical visitation of pestilence. River nuisance has been successfully avoided in European cities by the construction of interceptors along the river banks.

When a German engineer was asked by a prominent sanitarian from New York how they could prevail upon their people or government to vote the money for sewage disposal he declared it was "due to what would be not understood by the people in America, viz.: 'Culture.'" Views of Dusseldorf and Dresden emphasize the possibilities for beautification and commercial development along our Schuylkill River and certain portions of the Delaware River, after the removal of sewage pollution.

Lessons. The choice of a certain process can not be made because of its reputation for effectiveness, but the design must be determined upon only after all phases of the local conditions are considered, starting with the characteristics, size and volume of the river into which final disposal is to be made, and adopting the most economical system, the effluent from which will not unduly overload the river, and which will utilize the available diluting capacity of said river, or parts of a river.

The lessons learned from an inspection of European cities may be briefly summed up as follows: Collecting systems are designed with the most minute attention to economy, therefore along scientific lines.

The quality of material and workmanship in sewer construction are superfine, due in a measure to mechanics wages being one-third of ours.

For the best developed screening appliances we must look to Germany.

Tanks, both on account of economies in areas and scientific design for construction and operation have been developed to a better standard in Germany than elsewhere.

Percolating filters, and the operation thereof may be best studied in England. Scientific experimentation on this system has been more thoroughly carried out in Paris.

The investigations upon river dilution have been carried on more thoroughly in Germany.

Sludge disposal, except where it is carried to sea, has not been solved in England. In Germany, it has been satisfactorily solved by several methods.

The English sanitary world is hopeful that we are on the eve of developing a more intensive, economical and effective means of treatment than the percolating filter.

Having the advantage of observing the operation of all types of disposal works in European cities, lacking the prejudices of the Germans and English against the works of each other, the American Engineer is fortunate in that he may assimilate the best from each, and by proper combinations, with his ingenuity adapting and improving on their plants, he may and in certain instances has produced works which may be said to be the last word in sewage disposal.

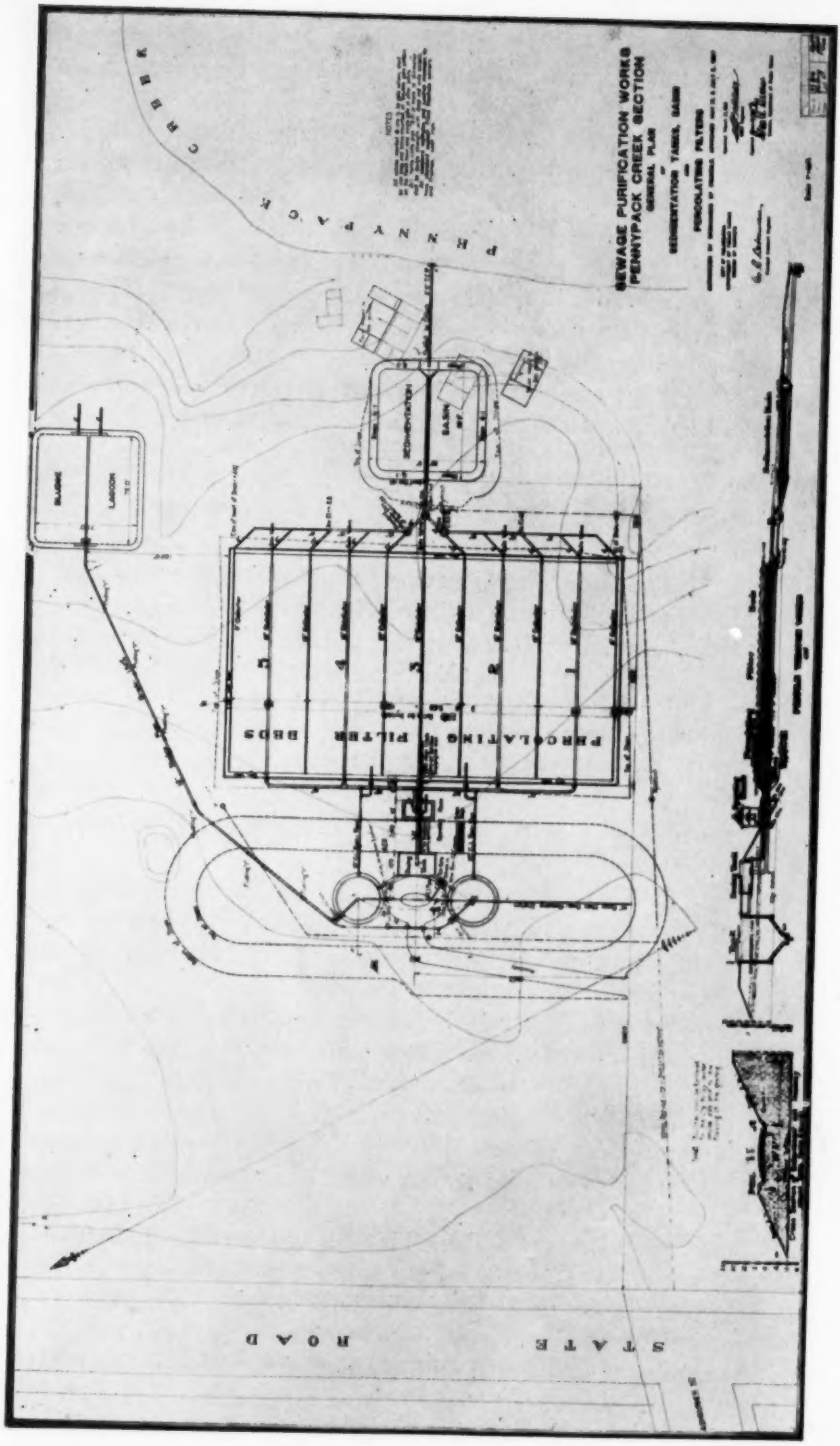
PHILADELPHIA

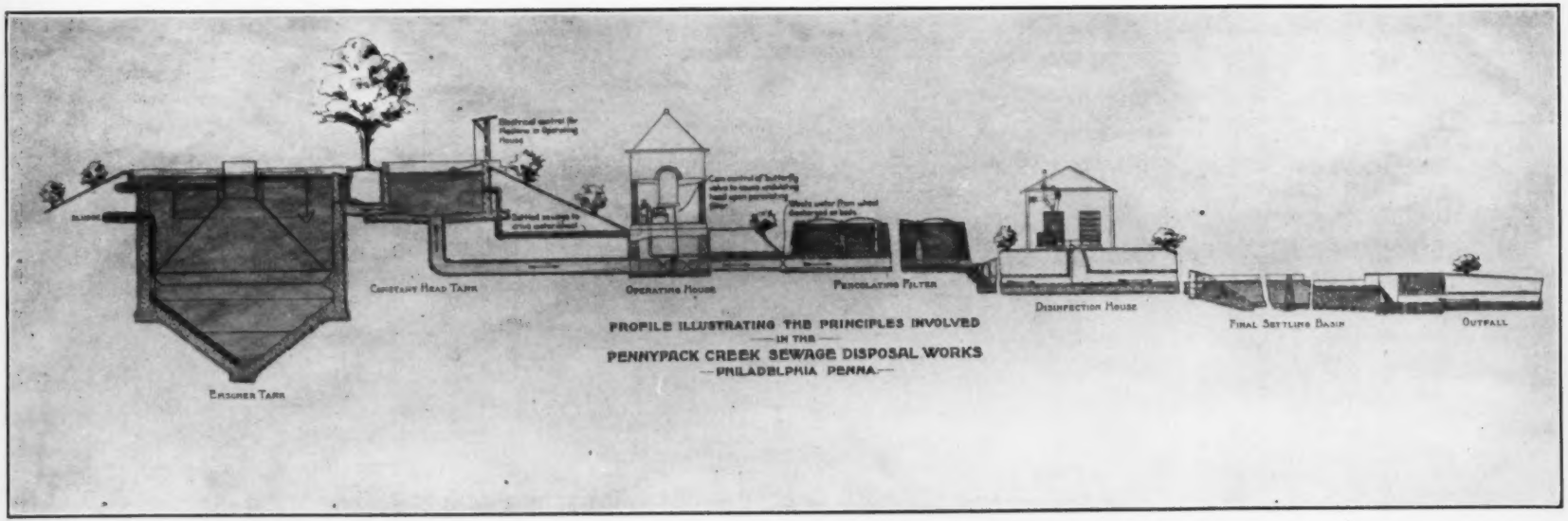
Testing station. For two years (1909–11) the city of Philadelphia operated an experiment station in which various methods and combinations of sewage treatment were studied and their comparative merits determined.

Pennypack Creek. Early in 1912 a sewage treatment works was completed, which had for its object the restoration of the polluted Pennypack Creek, and the elimination of nuisance from three city penal or charitable institutions and the village of Holmesburg, which menaced through the said creek, the intake of the Torresdale water filters, supplying two-thirds of the water consumed by the entire city.

Collector. A collector has been built along the creek to which is diverted the dry weather flow from a number of combined sewers and the whole flow from the city institutions.

Works. After passing a small grit chamber the sewage is pumped by two horizontal centrifugal pumps operated by Westinghouse gas

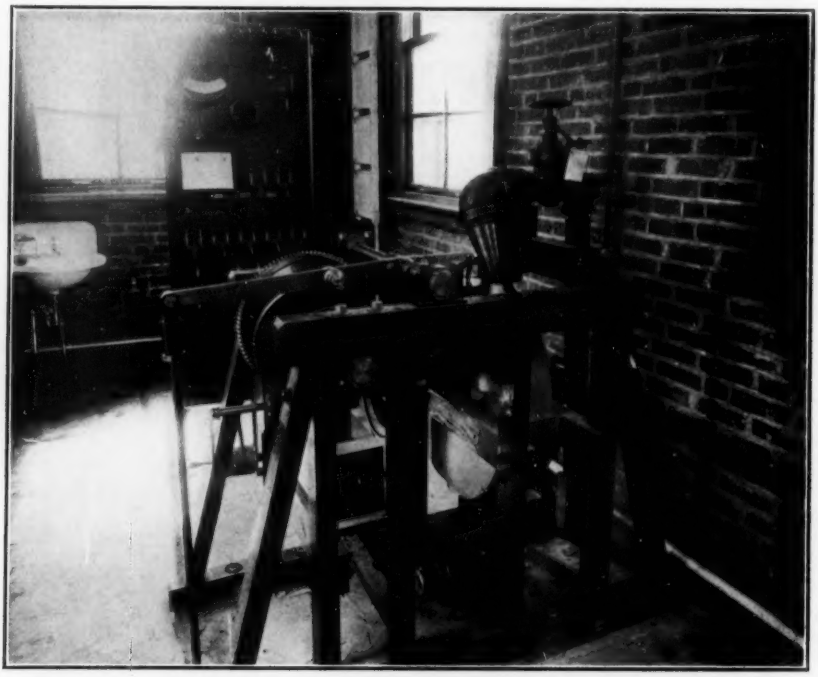

SEWAGE PURIFICATION WORKS
PENNYPACK CREEK SECTION
GENERAL PLAN
PENNYPACK CREEK
PERCOLATING FILTER BEDS
STATE ROAD



Sectional Diagram: Pennypack Creek Sewage Disposal Works, Philadelphia, Pa.

engines actuated by a suction gas producer through about three-fifths of a mile of force main to the treatment works located upon ground adjacent to the water filters.

The works designed for a capacity of 2,000,000 gallons a day consist of two circular sedimentation and sludge digestion tanks of the Emscher type, the first full sized tanks under construction in the United States, operated in parallel, in which the sewage is sub-



Operating Mechanism, Controlling Distribution on Percolating Filters, Pennypack Creek Works

mitted to nominally two hours sedimentation, the effluent from which concentrated in an equalizing or dosing tank is distributed upon a percolating filter.

The filter covers one acre of area, composed of crushed trap rock, size 1 to 3 inches, with half tile floor drains aligned between two one-half beds, there being five such divisions.

Distribution is by means of 6-inch vitrified pipe in concrete walls, with vertically placed T's at the risers, the latter being of wrought

iron, into the top of which, 6 inches above the surface of the filter, are screwed the Taylor square spray nozzles, spaced 10.8 feet apart.

The operating mechanism, somewhat unique in plants of this kind and original with the Bureau of Surveys' assistants, partially developed in the testing station, consists of a water wheel supplied from the dosing tank under a fluctuating head of from $4\frac{1}{2}$ to $7\frac{1}{2}$ feet and wasting to the surface of the filter. An electric motor can be thrown in automatically in case of failure to act on the part of the wheel.

The wheel actuates a shaft upon which are set cams which control the action of a butterfly valve set in the 24-inch distributing line and are in return rendered idle or active by an electrical mechanism operated automatically by float in the dosing tank.

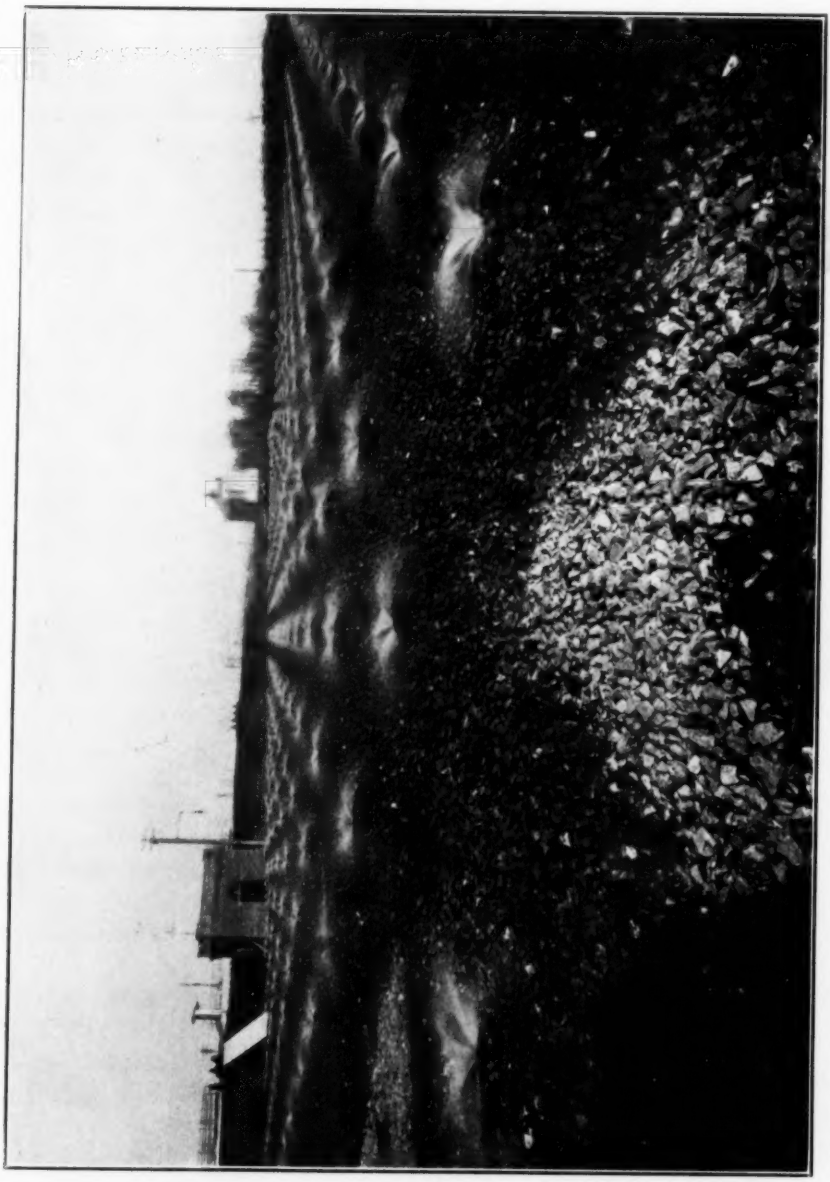
Variations in flow to the works are automatically passed on to the filters by aid of the above mechanism, a quantity greater than the average throwing into action the high rate cam upon the operating mechanism, and a small quantity causing the machine to run idle until a certain height is reached in the dosing tank, when the machine again is thrown into action.

The fluctuating spray from the fixed nozzles carried to a line which produces an overlap of 6 inches secured by the mechanism ensures an equal distribution over the whole filter area and is equal in uniformity of distribution upon the area to the machine distributors in use abroad, but has the added value of a much higher rate of distribution.

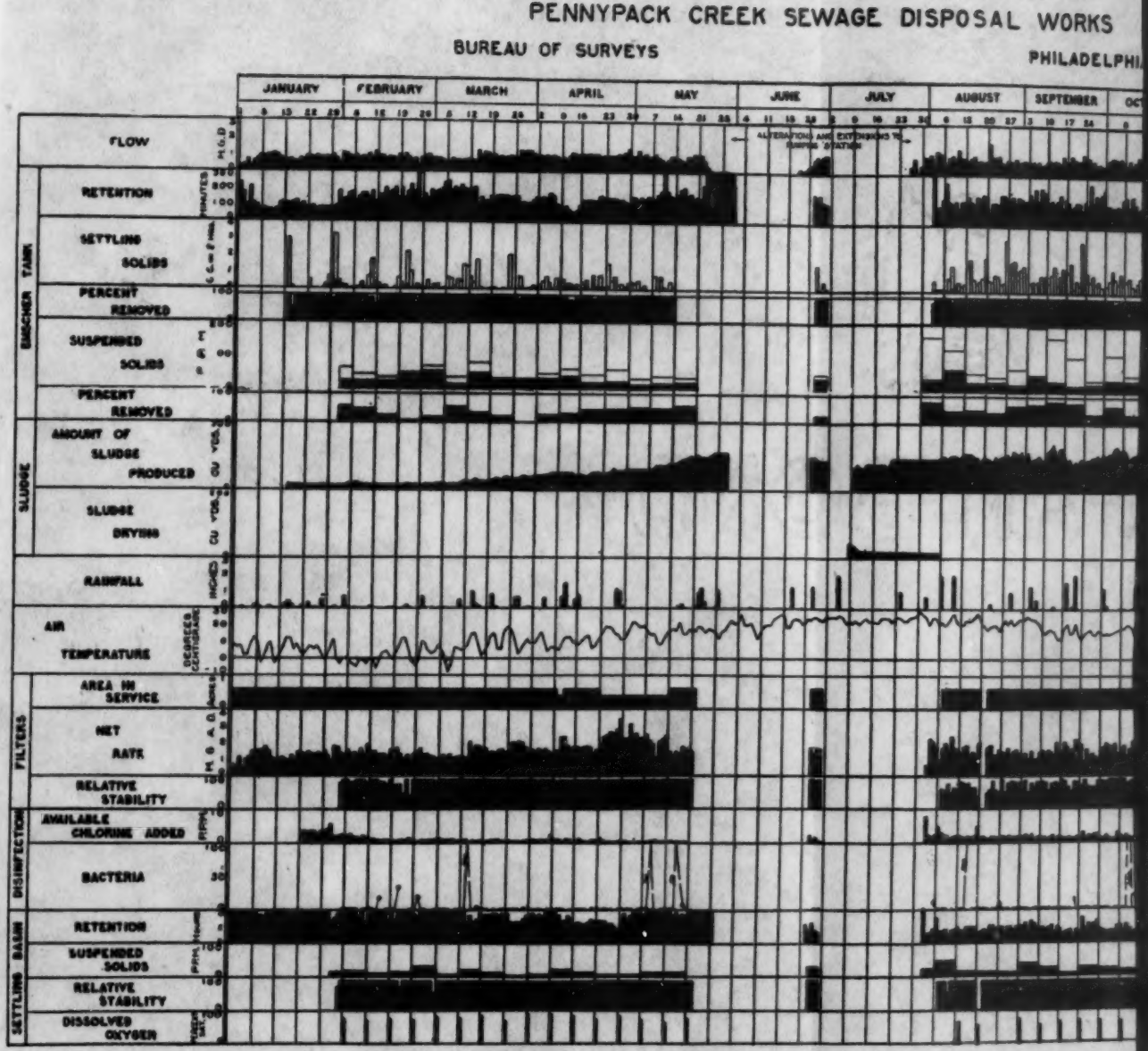
It is claimed for it that on account of the evenness of distribution a uniformly satisfactory effluent can be secured even when the filters are operated at a rate of 3,250,000 gallons per acre. When it is considered that 2,000,000 gallons per acre is a high rate under usual conditions, the amount that may be saved by adopting a satisfactory method of distribution in area of land and cost of filters is material.

After passing the filters and in order to comply with a condition of the permit of the State Department of Health, on account of the proximity of the works to the intake of the water filters the effluent is subjected to disinfection by hypochlorite of calcium secured by another device which is effective in avoiding the difficulties which have arisen in many other hypochlorite dosing devices.

It consists of a mixing tank, upon the floor level, from which the bleach cream is pumped to either of two solution tanks. The product of these tanks is further diluted before it runs through a



PERCOLATING FILTERS, PENNYPACK CREEK WORKS, OPERATING HOUSE AND EMSCHER TANKS IN BACKGROUND



DIAGRAMMATIC HISTORY OF PENNYPACK CREEK WORKS 1913

SEWAGE DISPOSAL WORKS

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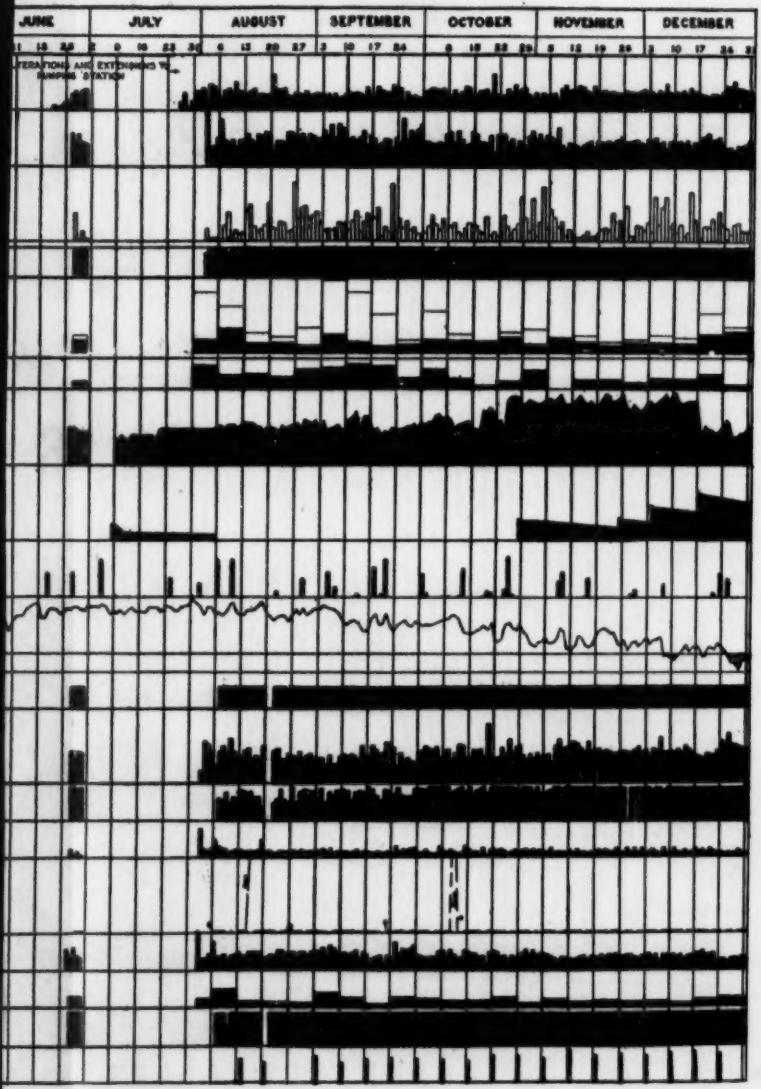


YPACK CREEK WORKS 1913

perforated lead pipe, lying horizontally in the effluent conduit thus securing a complete admixture.

With an average flow of 1,000,000 gallons daily, 25 pounds of bleach representing one part per million available chlorine have secured an almost sterile effluent.

Having received its dose, the effluent is retained in the final sedimentation basin, for a nominal period of two and one-half hours where the mineralized solids washed from the percolating filter are deposited. The final effluent escapes over a weir to a semicircular channel terminating in a "V" notch weir the flow over which is recorded by a float operated electric automatic device, registering in the operating house.

The final effluent, discharged to the creek, has been deprived of its suspended solids, is clear, inodorous, perfectly stable and nearly sterilized.

Sludge from the Emscher tanks is discharged, without placing the tanks out of service, by utilizing the head of water upon the sludge discharge pipe, into an underdrained sand bed, where it dries in from a week to ten days.

Sludge digested in an Emscher tank of this type, after some of the troubles due to local conditions have been overcome and after it has reached the ripe stage, when discharged upon this bed, should be inodorous and may be and has been used without offense for the filling of low ground.

The plant as a whole is unobjectionable from odors, due in a large measure to the freshness of the sewage, the rapidity with which it is passed through the works, the practice of keeping cleaned the surfaces with which it comes in contact, and on account of the planting and well trimmed lawns, it is an attractive place to visit.

In all respects it compares favorably with any of the plants of European cities.

The last year's operation of the plant is shown upon accompanying diagram.

Expressed in figures as averages the results of operation are as follows:

1913 Averages

			Influent	*Effluent*
Quantity in m.g.d.	1	Suspended solids	64	19
Retention in Emscher tanks in hours	2½	Organic nitrogen	4.7	1.7
Rate of filtration in m.g.d.	1.67	Free ammonia	6.1	2.4
Amount available chlorine added in p.p.m.	1.6	Oxygen consumed 30 min. at 100°C	32.1	13.6
Retention in final settling basin in hours	2.6	Nitrates		2.3
Settling solids in Emscher influent cc per liter in 2 hours	1.23	Chlorine	29	
Settling solids in Emscher effluent	0.02	Alkalinity	54	
		Bacteria on litmus lactose agar at 37° in 24 hours, total	83,850	33
		Acid formers	60,500	3
		Resembling B. Coli	36,000	2
		Dissolved oxygen per cent saturation		73
		Relative stability		0.89

Suspended solids

	Total	*Fixed*	*Volatile*
Applied to filters	32	17	15
Effluent No. 1	32	20	12
Effluent No. 3	25	15	10
Effluent No. 5	23	15	8

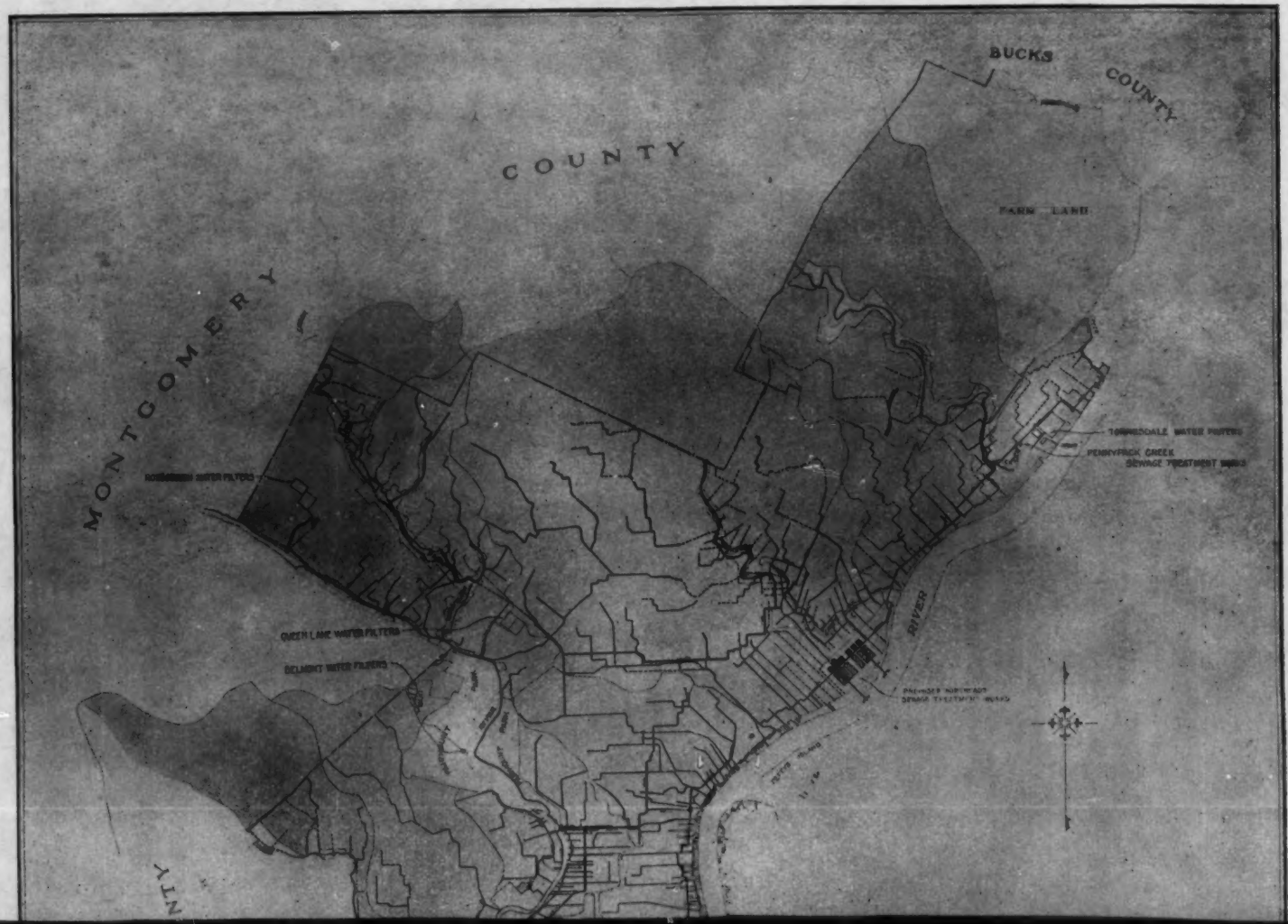
Sludge withdrawn averaged 1.2 cubic yds. per million gallons sewage.

Average analysis of sludge

Per cent moisture	75
Specific gravity	1.11
Percentage of the dry residue that is	
Volatile	40
Fixed	60
Fats	10

Plan for Philadelphia as a whole. The installation at Pennypack Creek is a pattern which may without doubt be applied to the ultimate treatment of the sewage for the entire city, when the sewage is intercepted by marginal sewers along the rivers, and carried to a number of suitable points for treatment.

A scheme to accomplish this which meets with favorable recommedation on the part of the city's officials, provides for clarification works in the northeast, southeast and southwest, discharging the effluents through submerged outlets into the channel of the Delaware


BUCKS
COUNTY
COUNTY
FARM LAND
MONTGOMERY
QUEEN LANE WATER FILTERS
BELMONT WATER FILTERS
RIVER


CITY OF PHILADELPHIA
PLAN FOR THE COLLECTION, TREATMENT AND DISPOSAL OF SEWAGE
DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS
1914
DELAWARE COUNTY
DELAWARE
DELAWARE COUNTY
DELAWARE
LEGEND
EXISTING WORKS
MAIN SEWER
WATER SUPPLY INTAKE AND PUMPING STATION
WATER SUPPLY FORCE MAIN
BOUNDARIES OF MAIN DRAINAGE AREAS
PROPOSED SEWERAGE WORKS
MAIN SEWER
INTERCEPTING SEWER
FORCE MAIN
SYPHON
PUMPING STATION
CLARIFICATION WORKS
OXIDATION WORKS

River, utilizing the capacity of the river for the completion of the treatment by dilution and oxidation. A comprehensive report upon this, one of the largest sewage disposal problems, is in course of preparation.

Prophecy. Harbor development, public health, sanitary requirements, the protection of the water supply of this and other cities, the increase in the culture of the people, together with the necessity of maintaining the international reputation of our city, all demand and will ultimately secure the accomplishment of this or a somewhat modified project as essential to proper municipal life in this twentieth century.

A WANDERER'S NOTES ON FOREIGN WATER SUPPLIES

By Louis L. Tribus, M. Am. Soc. C. E.,

Consulting Engineer

Public water supply has only been a matter of large consideration in the United States for a period of about ninety years, which may be divided for discussion into three groups of thirty years each.

In the first, the scattered "old oaken buckets" and the historic town pumps began to be superseded by central pumping stations, delivering river water into bored log distribution pipes, or in a few instances into cast iron pipe, imported chiefly from Scotland; storage cisterns were built and some measure of fire protection was given by the bucket brigades and multiple hand power pumps, but rare was the house that had other than a single tap and that usually in the back yard.

In the next period, sanitation began to receive attention, pressure was found necessary, and reservoirs conserved stream flow, at elevations to give gravity service, and of course cast iron replaced wood for pipes.

The epoch just closed was conspicuous in its earlier years through the extensive operations of private ownership franchise grabbing concerns, many of whose projects ended in financial disaster and as a logical outcome of giving away franchises without proper restrictions the more recent municipal ownership fad.

Now the country is well started on lines of bettering the sanitary surroundings of water supplies, developing high pressure fire protection systems, softening hard waters and valuing plants for just rate making, together with more efficient management.

This Association deserves much credit for the advance.

But for these notes, discussion of a paltry ninety years is not the thought; rather a few brief references to water systems of twice and thrice nine hundred years ago.

In Egypt the exhaust of the gasoline pump sounds oddly where it replaces the brown skinned Shadoof raisers (fig. 1), the patient

FIG. 1. RAISING WATER BY THE SHADOOF, ALONG THE NILE, EGYPT

FIG. 2. SAKYIEH, ANIMAL POWER—ENDLESS CHAIN—BUCKET HOIST—ELEPHANTINE ISLAND, OPPOSITE ASSOUAN, EGYPT

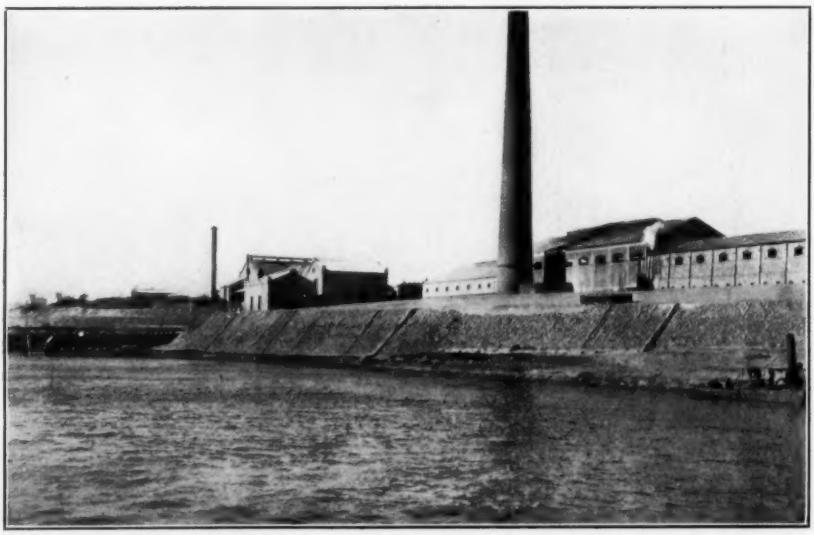


FIG. 3. ENGLISH IRRIGATION PUMPING STATION—ON THE NILE NEAR KOM OMBO, EGYPT

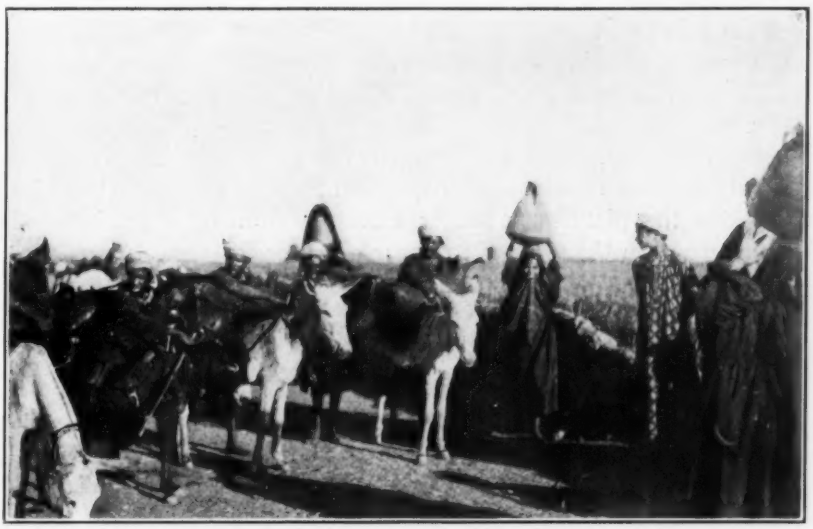


FIG. 4. WATER CARRIERS AT ESNEH, EGYPT

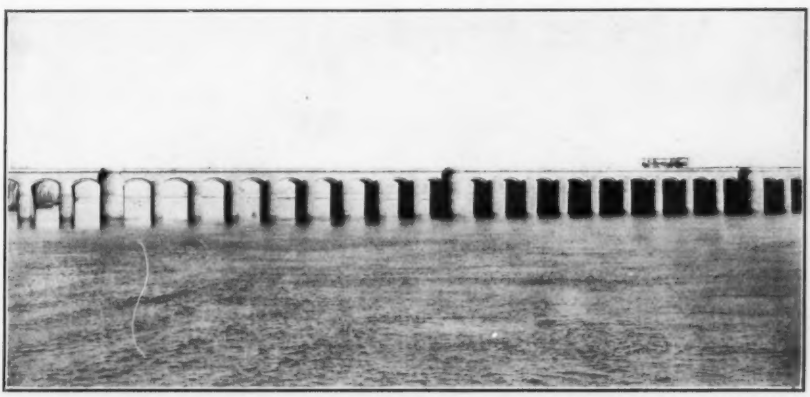


FIG. 5. REGULATING DAM (OR BARRAGE) ACROSS THE NILE NEAR ASSIOUT, EGYPT. LOW STAGE AND GATES CHIEFLY OPEN

circling donkey, ox, or camel raising the Sakyieh's endless chain of buckets (fig. 2), or the Michigan-built Archimedes Spiral. Two great steam plants for irrigation look oddly out of place on the banks of the Nile (fig. 3), but probably many a year will still pass before the women carrying earthenware jars on their heads, or donkeys with goatskin bottles will cease to be the village water purveyors (fig. 4).

Modern Cairo has a new piped water system with driven well supply and an excellent fire department service, but in the older portions the picturesque water carrier performs his semimusical functions as in the cities of our near neighbor, Mexico.

FIG. 6. TOP OF ASSOUAN DAM, EGYPT, DURING THE RAISING OF ITS LEVEL BY SEVEN METRES. FEB. 1910

The two problems in Egypt, of irrigation and water supply, are so intimately associated that work done primarily in interest of the former, will also facilitate to large degree, a solution of the latter.

The three great regulating dams crossing the Nile at Assiout (fig. 5), Esneh and Assouan (figs. 6–7) will retain for low water stages the advantages accruing during high water, with virtual elimination of the damage and inconvenience from uncontrolled flooding.

Most of the branch irrigation canals have heretofore been out of commission during low Nile (fig. 8), but with the enormous pond-

FIG. 7. TEMPLE ON THE ISLAND OF PHILAE, SUBMERGED BY WATERS IMPOUNDED BY ASSOUAN DAM—THE NILE, EGYPT

FIG. 8. ENTRANCE TO IRRIGATION CANAL—THE NILE, EGYPT

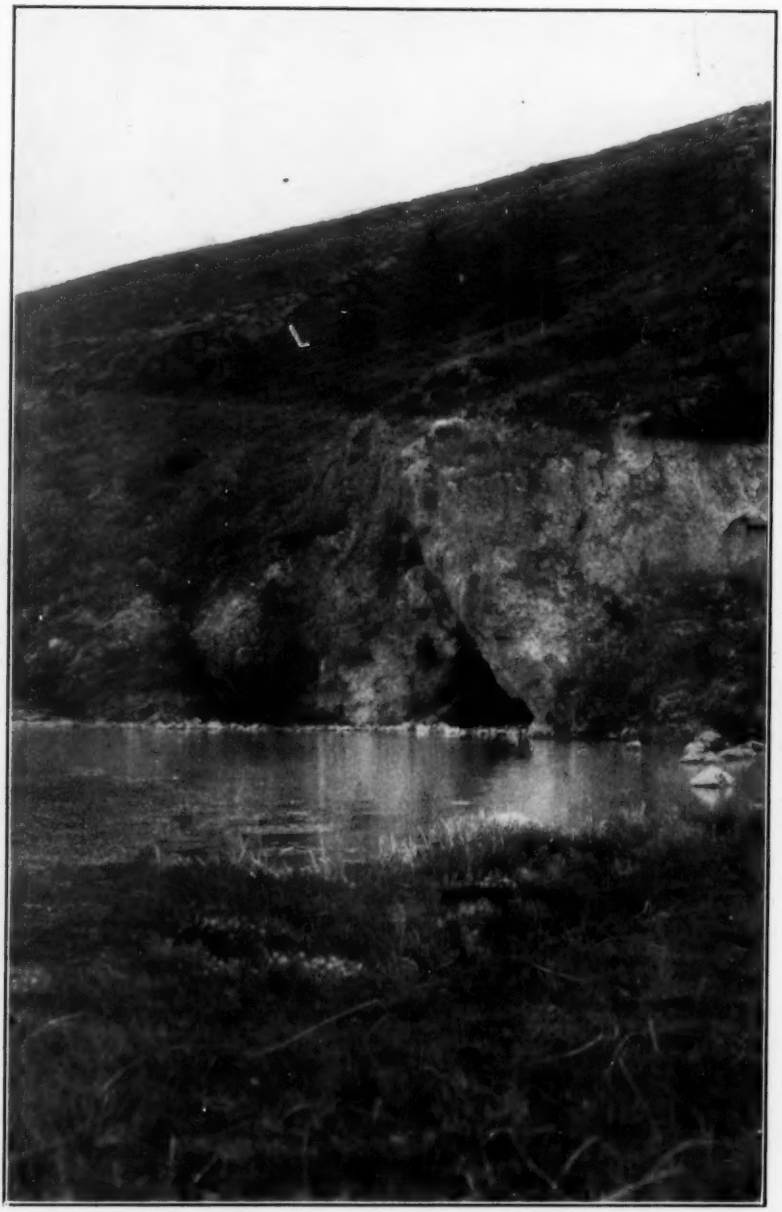


FIG. 9. GIDEON'S FOUNTAIN OR HARADS SPRING, FOOT OF MOUNT GILBOA—PALESTINE

age by the raised Assouan Dam, that condition will be largely remedied.

Many theories have been evolved as to the why and wherefore of the Sphinx; may we not advance a new one: Does it not represent an honored water works superintendent, instead of old King Kephren? Cut from the rocks of the hills in grateful appreciation, by Rameses the Great in recognition of the superintendents bearing the brunt of the kicks and growls of the enraged water

FIG. 10. ELISHA'S FOUNTAIN NEAR OLD JERICHO, PALESTINE—"BITTER WATERS TURNED TO SWEET"

users when the filter systems failed to remove the Nile's suspended matters. The stony stare acquired by long years of experience fully demonstrates the theory.

In touring Palestine, many a relic of an ancient conduit and canal may be observed, and in some instances one is inclined to believe that originally crude water power lifts were utilized to raise portions of the water to higher level canals or conduits (figs. 9–10). Generally springs were protected with stone curbing, and often

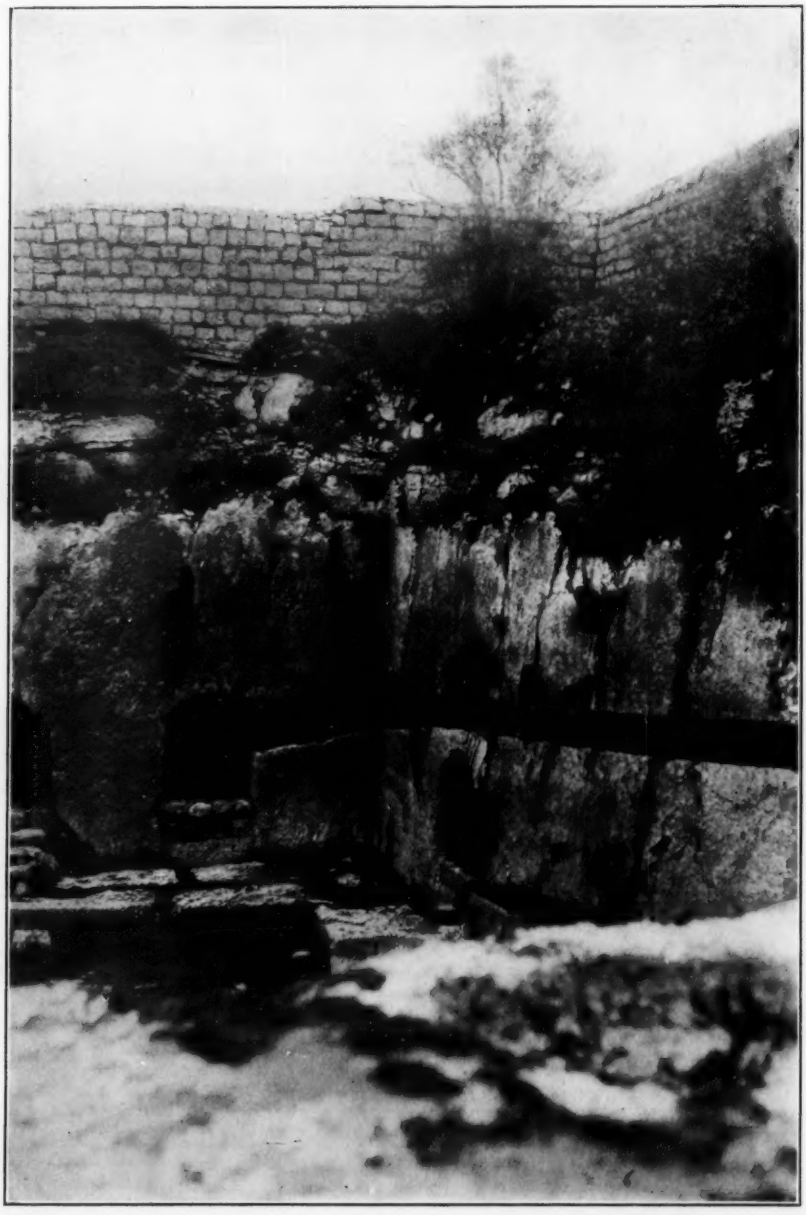


FIG. 11. ROCK CISTERN—SIDE WALL CONDUIT (INFLOW) JERUSALEM, PALESTINE

partially roofed over; in some cases wholly so. Jerusalem is supplied from great stone cisterns, springs cleaned out and walled up; every drop of water being valuable (fig. 11). King Hezekiah is credited with the construction of a very interesting winding, well-graded rock tunnel, some 1700 feet in length, 2½ feet in width and 4½ feet in height, conducting overflow waters from one of the middle level springs down to the famous Pool of Siloam (fig. 12), in which neighborhood washing is done, and from which the family water supply is carried away in the universal earthenware jars.

The mountains upon which Jerusalem is built are of limestone liberally fissured and caverned; a number of these not containing springs themselves have been enlarged and converted into storage reservoirs, called "pools" into which the jars are dipped. In view of limited water facilities, and perhaps inclination, bathing, aside from washing the face, hands and feet, is naturally a good deal of an annual custom, obligatory, however, at the Passover time, when clothing too must be clean or new, and household utensils be thoroughly washed or else be renewed.

Mohammedans are equally scrupulous as to the same degree of cleanliness; it is wise, however, to visit such lands before hot weather or after the annual rehabilitation of person and apparel.

Our own next door neighbor, Mexico, also has some such very praiseworthy habit of at least annual cleansing. Though a far cry from Palestine some similarity of customs and development suggests a word as to Mexico before continuing a jaunt in the "Near East." Several cities early constructed arched conduits to carry water at the hydraulic grade, and they still furnish fairly abundant municipal supplies.

Sometimes the Mexican structures were artistically embellished at important points (fig. 13), the suggestions, however, probably came from Europe rather than originating in the country, and are of Middle Age era rather than the early Christian centuries.

The spring at Guadelupe (fig. 14) is associated with an old legend to the effect that it came into existence when the Virgin Mary stepped on the ground, presumably to visit the cathedral which had been erected in her honor as the result of certain miraculous directing of an old Indian devotee, whose blanket she had impressed with an effigy of herself. As vouching for the truth of the legend the pictured greasy blanket hangs, framed in silver, in the cathedral's altar.

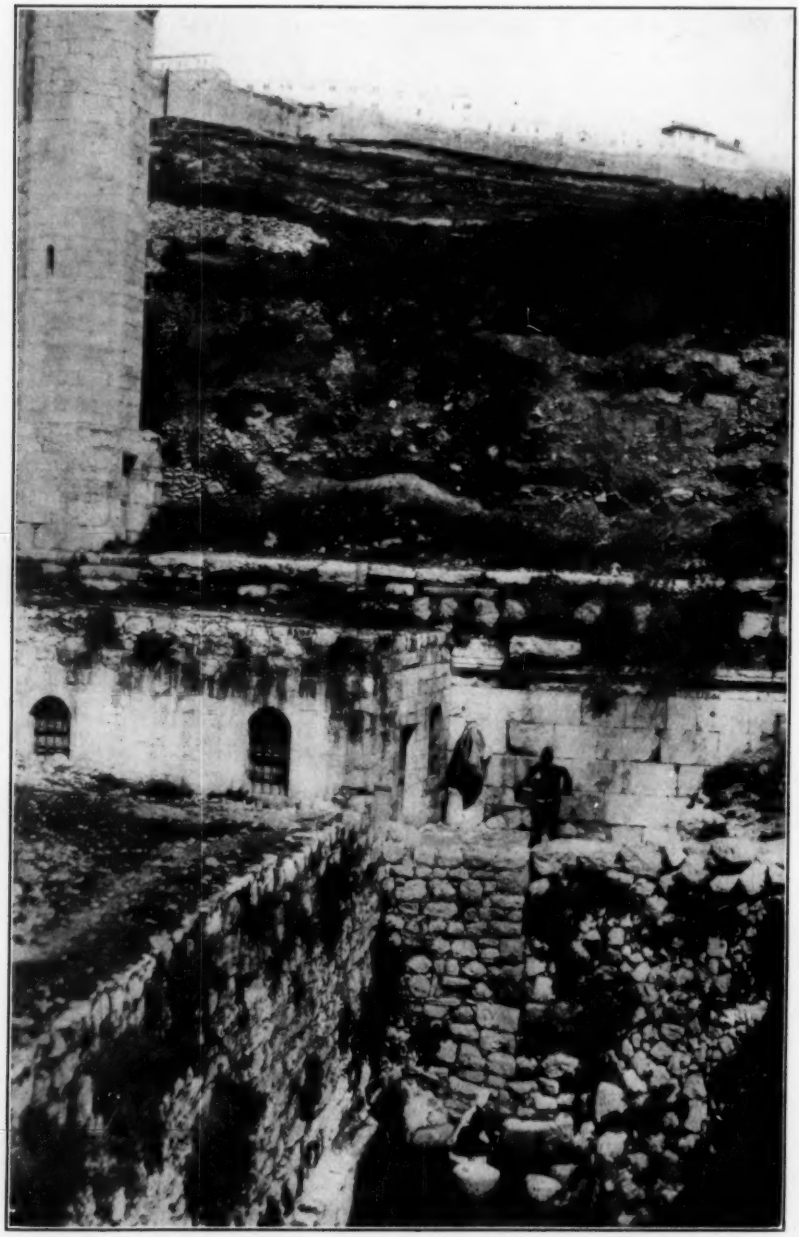


FIG. 12. POOL OF SILOAM AT FOOT OF HEZEKIAH'S TUNNEL—WALLS OF JERUSALEM AT TOP OF PICTURE—PALESTINE

The ancient cities of Asia Minor, Ephesus being typical, were well provided with public water supplies, ruins of arches supporting graded conduits still standing (fig. 15), though the present natives have reverted to the early and primitive carrying from the pool or spring; and storks have adopted some of the remaining towers for their homes, thus typifying the perennial springs of life.

Constantinople in very early days developed mountain sources into a municipal supply, conveying the water by several underground conduits to extensive covered columned cisterns (fig. 16),

FIG. 13. FOUNTAIN—MEXICO

whose presence in the city would be entirely unsuspected as buildings usually completely cover them.

One of the largest is near famous old San Sophia, and is entered by a stone stairway from a stable yard. That yard may be well drained away from the opening, but then again it may not.

From these cisterns the water is piped to numerous artistically decorated public fountains, and seems of excellent quality until one imagines the possibility of other stable yards; then bottled water from Switzerland becomes suddenly more attractive.

FIG. 14. SACRED SPRING—GUADELUPE, MEXICO

FIG. 15. RUINS OF ANCIENT AQUEDUCT—EPHESUS, ASIA MINOR

Every ancient city having Greek or Roman influence made much of public water supply, their baths being historic, the daily gathering places, not alone of patricians but of plebeians also.

In Old Corinth, said to have been one of the most luxurious and wickedest cities of all times, there still stands a portion of the ancient bath (fig. 17), and ruins of the market and forum and temple of Apollo. From the spring flows today as of yore, the water that filled the tanks, but now through wrought-iron pipes, supplying

FIG. 16. RESERVOIR OF THE 1000 COLUMNS, CONSTANTINOPLE, TURKEY

the modern village farther down-hill, the ancient and modern somewhat incongruously meeting.

All the world knows of the Roman aqueducts, the more ancient ones being carefully preserved as tourist attractors (fig. 18), while some still serve present day populations through the public fountains. These public fountains were as abundant in old Pompeii as the wineshops and that is saying a great deal.

Lead and earthenware pipes were both used for distribution.

FIG. 17. RUINS OF BATH—OLD CORINTH, GREECE—SOURCE OF WATER SUPPLY FOR MODERN CORINTH

FIG. 18. OLD ROMAN AQUEDUCT, ITALY

FIG. 19. STREET FOUNTAIN—CROSSING STONES—RUINS—POMPEII, ITALY

FIG. 20. HOUSE OF PANZA, SHOWING FRONT COURT FOUNTAIN—POMPEII, ITALY

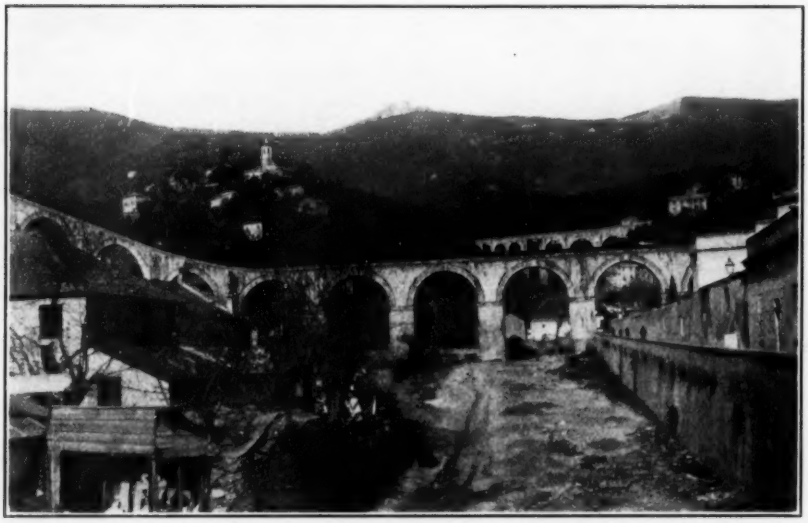


FIG. 21. AQUEDUCTS—GENOA, ITALY

FIG. 22. BEGINNING OF GREAT AQUEDUCT THAT SUPPLIES THE FOUNTAINS AT VERSAILLES, FRANCE

The illustration (fig. 19), shows one of the street-side white marble drinking troughs for horses and the inflow nozzle for man. Then may also be noted the crossing stones for pedestrians, raised about 15 inches above the street pavement, not to provide against mud or water, but because the pavement was usually protected against wear by that depth of earth. Horses did not wear shoes, so that the pavements, or literally foundations for the earthway, were thus covered for their comfort also. White marble corner tablets cut with letters and figures indicated street names and districts; those shown in the picture are as uncovered recently, from their burial in A.D. 79 by the eruption of Vesuvius that destroyed Pompeii and Herculaneum.

The House of Panza (fig. 20), representative of the more palatial houses exhibits the typical front court water pool, probably not used so much for bathing as for adornment and fancied coolness.

In Genoa ancient and modern conduits are side by side, both in use (fig. 21); one using the hydraulic grade on the hill contours, the other siphonage across the valley.

At Versailles, a great aqueduct (fig. 22) is filled with water pumped from the Seine through pipes for a short distance, then gravity flow to the great fountains (fig. 23) which first charmed royalty and its visitors and since then several generations of tourists.

Another odd water system, strictly modern, however, serves the inhabitants of Gibraltar. About ten acres of mountain side have been smoothly concreted and provided with grooves or ditches, (fig. 24), the concrete acting as a precipitation agent, condensing the moisture laden breezes coming from over the Mediterranean, while the grooves collect and convey the water into underground rock-hewn cisterns. Very abundant success cannot be claimed, but everything goes that yields some water for the inhabitants of the "Prudential's" rock.

This paramount commodity of life has been, perhaps, more abused, less protected and less intelligently handled by civilized moderns, until very recent years, than any other necessity, little having been learned or heeded from the works of antiquity, and even today cities grudge the expense of even half-way protection, instead of being anxious to do all that is possible for conservation, purification and maximum economy in use of that marvelous mixture of gases which, combined, is called "water."

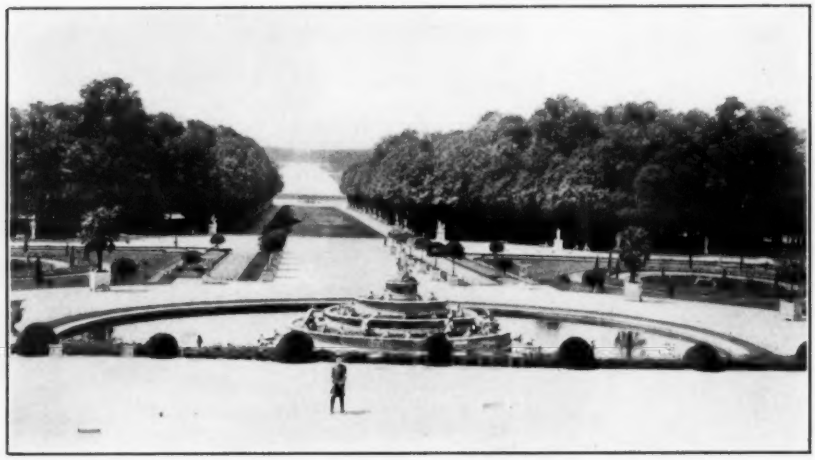


FIG. 23. ONE OF THE GREAT FOUNTAINS—VERSAILLES, FRANCE

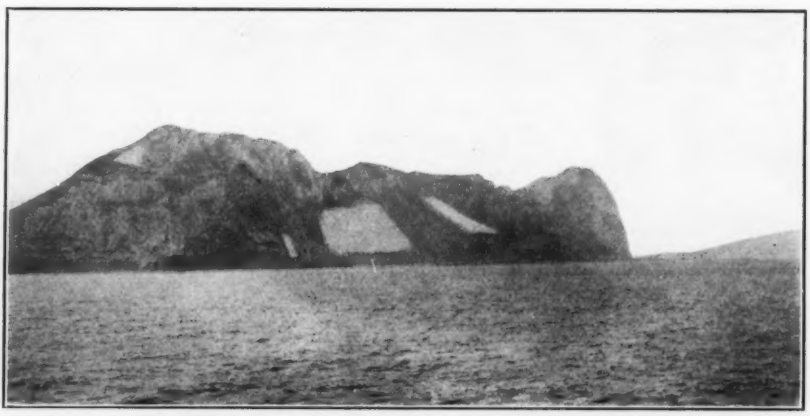


FIG. 24. CONCRETE COLLECTING SLOPES FOR GIBRALTAR'S WATER SUPPLY